Applied Science

APRIL, 1959

ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

ST. LOUIS

BONDED AIRCRAFT STRUCTURES—*Automation Speeds Production* **20**

ANIMAL GLUES FOR WOOD BONDS—*A New Look at an Old High Polymer* **25**

POLYURETHANE ADHESIVES—*Room-Temperature Curing System* **29**

Adhesives and Equipment for

Glue Lap Corrugated Containers

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ADHESIVES AGE

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About the Cover Photograph

The close-up shot of a stack of folded corrugated containers is used here by courtesy of the International Paper Box Machine Company. For a survey of new container industry techniques and trends see the article beginning on page 34.

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PALMERTON PUBLISHING CO., INC.

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News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

This "100%-solids" adhesive flows like a heavy-bodied motor oil

TECHNICAL DATA ON

Bondmaster® M648T

A free-flowing, high strength, room-temperature-curing, 100%-reactive, two-component, formulated epoxy adhesive designed for bonding all metals and other rigid materials (such as glass, ceramics, plastics, plastic foams, and structural laminates) to themselves and to each other.

BOND CHARACTERISTICS

Fully cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

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Mixed BONDMASTER M648T may be applied with trowel, spatula, knife, roller, brush, etc. Apply enough *mixed* BONDMASTER 648T to fill all cavities and depressions in both surfaces *and* to leave about 4 additional mils of adhesive on each side. Press together firmly to establish and maintain intimate contact, and cure. Pressure is not required during cure.

SPECIFICATIONS

VISCOSITY (mixed): about 10,000 cps. COLOR: clear, pale amber. BASE: modified epoxy. SOLIDS: 100%. HARDENERS: CH-8 for balance of all properties; CH-16 for best shock and peel strengths. WEIGHT PER GALLON: about 10 lbs. STORAGE: 1 year, unmixed. CONTAINERS: 1-gal. cans; 5-gal. pails; 55-gal. drums.

R&A SINCE 1913

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WRITE FOR FURTHER DATA

Write for Technical Data Sheet describing this 100%-reactive, free-flowing liquid epoxy adhesive formulation. We will be glad to send a free evaluation sample as well if you will describe your bonding problem in detail.

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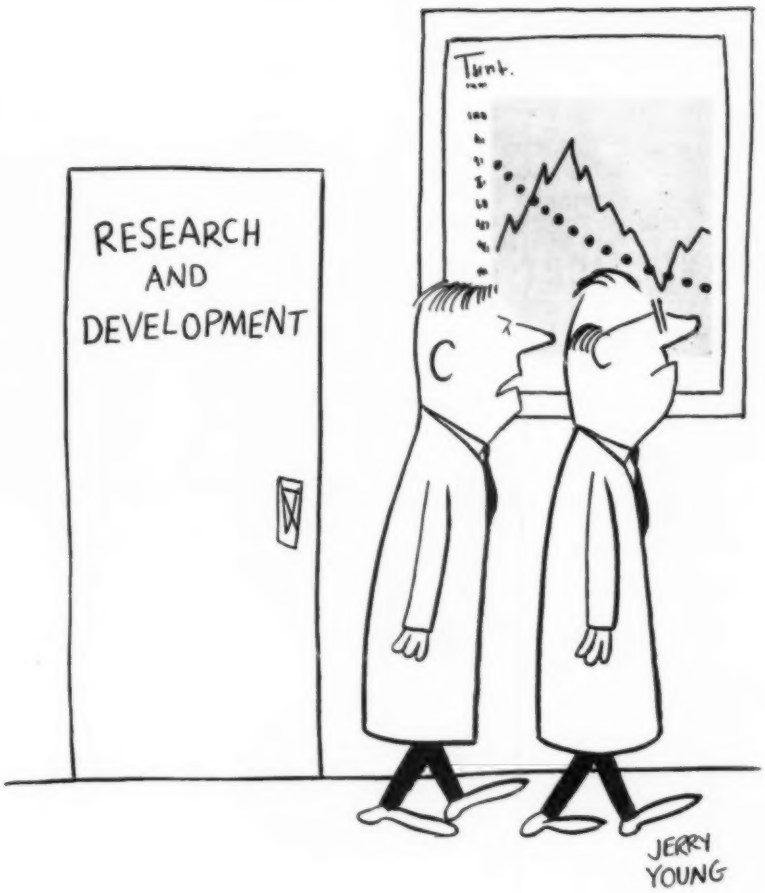
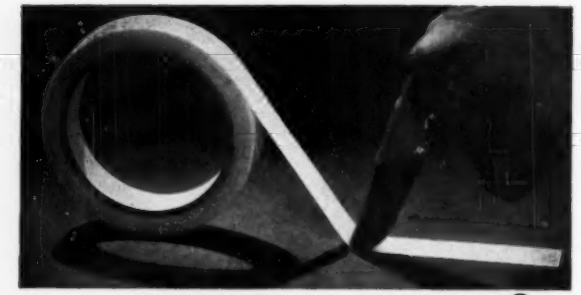
EDITORIAL

Ain't It The Truth?



"Something inside of me dies a little every time I hear our thixotropic, room-temperature curing, duo-component, micro-shrinking, solvent free, modified epoxy adhesive referred to as 'goo'."



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For -100°F to 500°F applications

TEMP-R-TAPE® C, CHR's newest pressure-sensitive tape, is made of ultra-thin, high dielectric, cast Teflon film to which a silicone polymer adhesive has been applied. Both pressure-sensitive and thermal curing, the adhesive sticks well to any surface over a −100°F to 500°F (−70°C to 260°C) temperature range. Providing an easy-to-apply, extremely thin, high dielectric insulator (2750 volts/mil), TEMP-R-TAPE C was designed for and is now being used in the manufacture of miniature electronic units to withstand Class H and higher temperature requirements. *Send for data on TEMP-R-TAPE C and CHR's other extreme temperature, electrical and mechanical pressure-sensitive tapes.*

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CONSULTANT'S CORNER

By Dr. Irving Skeist

High Temperature Adhesives for Metal to Insulation

Question: We are in the contracting business and apply insulating materials and also handle this material and its accessories for resale. Numerous times we have been confronted with the problem of applying adhesives to metal for application of metal fasteners such as stic klips and gemco clips, etc. We are wondering if there is an adhesive for high temperatures up to 1000°.

Answer: There are at present no completely satisfactory adhesives for bonding metal to insulation for high temperature service. Sodium silicate—water glass—is among the materials that come the closest. Many laboratories are working toward the goal of high temperature adhesives suitable for jet aircraft and space vehicles, and progress is being made. What is desired is a material that will have the heat-resistance of inorganic cements, combined with the strength and toughness of the organic polymers.

Metals may be composited by welding, soldering or brazing, to give joints that are strong and tough. There are limitations, however. Both adherends must be metal. Furthermore, the welding technique, which leads to the highest temperature resistance, requires that the adherends be of substantial thickness.

Oxides and other inorganic cements have wide application, and the bonds are generally heat-resistant. Sodium silicate, applied from concentrated aqueous solution, goes into wallboard, corrugated and solid paperboard, and many other products. It forms a good bond with asbestos and other insulating materials as well as with metals. One difficulty with sodium silicate is the ease with which it picks up moisture; another is its strong alkalinity. If your products are at times cold and exposed to dampness, the clips would have to be made of stainless steel to avoid chemical reaction. For some applications, it may be necessary to improve the toughness of the sodium silicate by compounding with various water-soluble organic resins; unfortunately, this cuts down the temperature resistance.

Chemically, sodium silicate could be considered a mixture of sodium oxide and silicon oxide. Many other silicate and oxide mixtures are bonding agents. Portland cement consists principally of calcium and aluminum silicates. Glass is a silicate made from sand, soda, lime, and possibly borax and other ingredients.

In addition to oxides, other inorganic compounds have adhesive characteristics in specialized applica-

tions, for example, calcium sulfate in plaster of Paris, zinc oxychloride and zinc phosphate in dental cements.

Much work is going on with glass frits for the bonding of metals for high speed aircraft and space craft, where maximum temperatures are high and temperature changes are rapid. The coefficient of thermal expansion of the glass frit must match that of the metal substrate closely to prevent separation as a result of temperature cycling. Problems of specific adhesion are being tackled through modification of the frit formula to provide chemical interlocking with the metal.

The inorganics tend to be deficient in specific adhesion and toughness, while meeting the high temperature requirements. Organic adhesives have the reverse problem; they generally deteriorate at temperatures far below 500°F., let alone 1000°F.

The phenol-formaldehyde resins, first of all synthetic organic adhesives, are still among the best of the organics as far as heat resistance is concerned. Their specific adhesion to metal is improved by alloying with epoxy resin. Metal structures for jet aircraft are being assembled with the aid of glass cloth tapes impregnated with epoxy-phenolic alloys or novolak-type epoxies.

Among other materials that are considered fairly heat-resistant, as organic materials go, are aromatic compounds such as the terephthalates, polycarbonates, and polyaromatic anhydrides. Promise is shown by other highly unsaturated resins such as polyvinylene, and by some saturated ring structures. The fluorocarbons have good heat stability, but lack adhesive characteristics.

If we expect to approach 1000°F. stability, we must get away from the purely organic materials. The silicones are semi-organic compounds with inorganic trunks and organic branches. Unfortunately, like the fluorocarbons, they do not show generally good adhesive properties.

Much research is underway on new types of inorganic-organic hybrids, in the hope of combining the best features of both to create plastics and adhesives that will stand up at high temperatures. Coordination compounds are made with zinc and other metals. Boron, phosphorus, titanium and aluminum are being utilized in conjunction with organic building blocks.

In some of the most promising work, the main chain of the molecule has the structure of an aluminum silicate or titanium silicate. Substituting the silicon atoms are phenyl groups which give the material enough plasticity so that it is workable. The molecule can be cross-linked at the aluminum or titanium atoms.

All this, while of no immediate help in solving your problem, shows that the resin chemists are trying. It is interesting that the most promising of the expensive new organic-inorganic hybrids are close in structure to one of the oldest and cheapest of adhesives, sodium silicate. An organic-modified synthetic silicate seems to be appearing as a faint blip on the radar screen as an answer to your problem; but it may take a few years to get here.

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

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new adhesives

AND ADHESIVE PRODUCTS

Metal Primer

Developed for bonding plastisols to sheet metals, A-978-B is a white colored, thin-viscosity, solvent-based, solution adhesive which is slightly more viscous than water. The most common method of application is by spray; however, application can also be made by brush, float, or roller. This thermosetting adhesive produces a semi-rigid tough bond upon the application of heat. In laboratory tests, a ten mil film thickness of plastisol adhered to a steel surface with A-978-B demonstrated a high order of adhesion even after the base metal had been elongated 35 per cent and subjected to the following: (1) boiling water for 30 minutes, (2) 200° F. dry heat for seven days, (3) tap water at 70°F. for 240 hours, and (4) humid storage at 160°F. and 100 per cent RH for 1000 hours. In addition, excellent adhesion was obtained with a ten mil film thickness of plastisol adhered to a steel surface with A-978-B after the coated steel surface had been immersed in detergent and salt solution for 200 hours at 140°F. and then bent 180°. *The B. F. Goodrich Co.* **P-88**

Gummed Textile Labels

Fabri-Klean Labels use a new peelable textile gumming which is said to leave no residue. They can be used on any textile: natural or synthetic, woven or knitted. Application is during the regular pressing operation, steam or dry, or by use of a regular hand iron. No special labeling equipment is required, and label moistening is eliminated. The labels are said to withstand repeated flexing or rough handling, yet they peel off easily. There is no necessity to prewash the fabric before use. *Dennison Mfg. Co.* **P-89**

Liquid Rubber Binder

Waste foam rubber and polyurethane scraps can be turned into new sheets or molded foam rubber articles with Rubtex, a liquid rubber binder. Both similar and mixed scrap derived from natural rubber, synthetic rubber or scrap vinyl foam can be bonded with this liquid polymer. It may be used to blend polyether into usable slabs; to blend vinyl foam scrap with both polyurethane scrap foam and natural rubber scrap; and to make flexible cork sheets by mixing the binder with cork granules. Leather dust and chips can also be blended with Rubtex to produce a leather-like material, and wood flour can be combined with Rubtex to produce a lower cost bonded foam. Available in quantities from one pint to 55 gallons, when Rubtex is kept in a tightly closed container it has a long shelf life. Other features of the product include non-flammability, self-vulcanization and heat-resistance. *Rubba, Inc.* **P-90**

Adhesive For Mylar

A strong, flexible, solvent-resistant adhesive, Bondmaster L379 is specially formulated for laminating Mylar to resin-impregnated asbestos papers,

kraft papers, rag papers, varnished fabrics and papers, and similar electrical insulating materials. Laminations made with this material are used as phase and layer insulations in electric motors, generators and transformers. The new synthetic rubber-resin adhesive is reported to have superior resistance to organic solvents and hot oils. For example, after four hours immersion in toluol, it retains nearly all of its initial strength while wet and recovers complete strength after drying. This permits electrical machinery insulated with laminations containing the new adhesive to be dipped in varnishes containing aromatic solvents.

The formulation features superior resistance to heat-aging, enabling Mylar-to-rag-paper laminations to pass Class B insulation heat-aging tests such as 96 hours at 125°C. Electrical properties of the adhesive are said to add to the dielectric strength of the lamination. Bondmaster L379 is available in two solids concentrations: 20 per cent solid with a viscosity of 400-1000 cps, 30 per cent solids with a viscosity of 4000-7000 cps. *Rubber & Asbestos Corp.* **P-91**

Epoxy Adhesives

EC-1294, EC-1474 and EC-1472 are epoxy resin adhesives that cure at room temperature and under contact pressure to a strong solid state without forming volatile by-products. EC-1294 cures to a clear hard light amber-colored material that has good machining properties and adheres to aluminum, steel, brass, glass and many plastics. The addition of aluminum powder makes it a metallic appearing sealer for filling-in or eliminating surface cracks, joints, etc. Depending upon the application, it may be cured with EC-1295 or EC-1468 activators. EC-1474 is designed for use where cost is a major factor and high shear strength and light color are not necessary. It cures with the addition of EC-1475 accelerator. Where good flexibility, shock and peel resistance is desired, EC-1472 is recommended by the manufacturer. It can be mixed in equal parts with its activator, EC-1473. After a seven day room temperature cure, the adhesive is said to present an excellent balance of properties. Tests indicate shear strengths of 3430 psi at room temperature and 2030 psi at −65°F. This adhesive should not be used in applications where temperatures above 120°F. are encountered. *Adhesives, Coatings & Sealers Div., Minnesota Mining & Mfg. Co.* **P-92**

Self-Sealing Washer

Bonded to the underside of the Bartite Sealing Washer is a measured amount of sealing compound. When pressure is applied, the dome of the washer compresses slightly and forces the sealant to flow in three directions. The polyvinyl chloride base compound flows downward to seal the space between the clearance hole and fastener threads; outward to seal the space between the contoured underside of the washer and the surface of the fastened material; and upward to seal the space between the fastener head and washer hole. The sealing compound is stable and

non-aging. It can withstand temperatures from —100° to 250°F. without change, and it will not split or ozone-check under pressure. Under actual tests, the compound has provided a secure seal against water, oils, greases, acids, alkalis, salts, alcohols, hydrocarbons and ozone. *L. J. Barwood Mfg. Co., Inc.* P-93

Contact Bondant

Because it is a water-phase contact adhesive, Hybond "100" is recommended by the manufacturer for laminating operations where unusually critical fire hazards exist. Fea-

tures of the adhesive include excellent heat resistance, high early and dead-load strength, and ease of application by either brush, spray or roller. Bonding is accomplished by means of instantaneous pressure alone—no clamps, presses or heat-reactive procedures and equipment are required. Hybond "100" is suitable for lamination of both similar and dissimilar materials including plywood, plastic laminates, wood panelling, fibreboard, leather, fabric, linoleum, wallboard, wood veneer, etc. *Pierce & Stevens Chemical Corp.* P-94

Masking Tape

Made of a six mil specially impregnated rope paper, Permacel 729 is an extra strength flatback masking tape. It has a stain and heat resistant adhesive with quick stick and high holding properties. Other characteristics include high tensile strength, and abrasion and tear resistance. The tape can be used for masking glass, metal and plastics during light sand blasting; masking for strip polishing; splicing linoleum, felt and similar materials. It is said to be rugged enough to be used for heavy duty holding and packaging including strapping and sealing coils, cartons and bags. *Permacel.* P-95

Structural Adhesives

Instant-Lok adhesives are contact cements based on oil-resistant elastomers and synthetic resins dissolved in a blend of organic solvent. The choice of modifying ingredients determines the specific adhesive characteristics. Bond strength, fatigue resistance, assembly time, heat resistance and other properties can be tailored to fit a particular application. Instant-Lok 4000 is very fast drying and has a limited tack range. For optimum results it should be used for hot bonding techniques or rapid assembly. Instant-Lok 4010 is a fast setting structural grade contact cement with a maximum open assembly time of 30 minutes. Instant-Lok 4020 is a general purpose contact cement with a long tack range. It has a maximum open assembly time of one hour, and it can be used in many hand operations. Instant-Lok 4030 is a structural grade contact cement for use in applications where a non-flammable product is required. It is fast setting and has a maximum open assembly time of 20 minutes.

The series also includes a water-based elastomeric adhesive designated as Instant-Lok 4300. It is said to have instant bonding characteristics normally associated with organic, solvent-based contact cements. *Structural Products Div., National Starch Products Inc.* P-96

Insulation Adhesive

The application of rigid low temperature insulation can be facilitated with Insulgrip, a two component, cold-applied, asphaltic adhesive which provides a moisture and vapor seal. It can be used with cork, rock cork, expanded and foamed polystyrene and similar insulation media. Open time for this adhesive is approximately 15 minutes, depending on temperature and atmospheric conditions. Application is by trowel to the face of the insualtion unit at the rate of one pound per square foot. This allows for a ⅛-inch coat. Depending on temperature and atmospheric conditions, bonding time is from one-half day to three or four days. *The Borden Chemical Co.* P-97

FOR MORE INFORMATION on the new adhesives described in these columns, use the Reader's Service Card elsewhere in this issue.

Shrinkproof Sealant

Used extensively in sealing fuel tanks and pressurized cabins of jet aircraft, PR-1422, a polysulfide liquid polymer base sealing compound, is expected to find a variety of industrial uses. At temperatures of from —65° to 275°F., the sealant is said to be highly resistant to alcohol, lubricating oils, hydraulic fluids, and water. It is supplied in two consistencies. Class A is brush applied, Class B is of a non-sag consistency and can be applied with an extrusion gun or injection gun on overhead or vertical seams. Cured at room temperature, the sealant results in a resilient rubber with a minimum of shrinkage. *Products Research Co.* P-98

General Repair Material

Plastic Mastic, an epoxy-polyamide chemical compound, is an all-purpose general repair material which is said to be permanently effective with concrete, metals, wood, ceramics, glass, rubber, cloth, paper and most plastics. It is supplied in a two-can kit: one can contains the base and the other the hardener. The base material is a thick white paste

containing an epoxy resin: a condensation product resulting from the reaction of bisphenol-A and epichlorohydrin. The hardener is a thick black paste whose resin is an amine bearing polyamide known as Versamid. When these two resins are mixed they form a thermosetting plastic which will not revert to its original softness. Because it contains no volatile solvents, Plastic Mastic eliminates problems of fire hazard, evaporation and shrinkage after curing. At temperatures of 70-100°F. the product cures in three to six hours. It can be cured in five to ten minutes by the application of heat. *Williamson Adhesives, Inc.* P-99

letters to the editor

Economics

Dear Sir:

As the editor of a publication whose primary function, it would seem to this writer, is one of guiding its readers either optimistically or pessimistically, it would seem that you would be more careful insofar as your selection of economists are concerned. It would further seem to this small intrepreneur that the privilege of using your editorial pages is one of great responsibility, and even after you have made your final selection of the "Guiding Spirit" you should still say "no."

The January issue of ADHESIVES AGE is typical and certainly should your average reader take cognizance of what you say, your nationwide bankruptcies would be even higher over the 300 mark than they are this moment. I liked particularly the phase, and I quote, ". . . expansion will be rapid, almost explosive, in the first six months of 1959 . . ."

Explosive does not seem to be the word, especially in view of the fact that ⅓ of the first half of 1959 is now past and we have in the State of New Jersey, jobless up to 25,000 people, practically equal to the recession peak of ten months ago; Brooklyn Navy Yard laying off 5,000 people; Chicago in distress with unemployment double what it was a year ago at this time.

The State of Pennsylvania has practically no funds for further compensation, reserves to a one-month level in payment; unemployment in Pittsburgh at 112,000 in comparison with 54,000 a year ago at this time; Bridgeport with a total of 13,300 unemployed, representing 9.4% of all its workers as against 5.1% of the total national average; Detroit a ghost city; General Motors with 387,000 hourly workers last year at this time, now down to 320,000; Ford Engine plant working a short week; Buick laying off 2,000 people last week; Fisher Body furloughing 400 people, and much more too numerous to mention. . . .

Now then, sir, if you will tell me how you came to the conclusion that the economy will grow a "thumping 8%" I would like to know and so would many others of your readers. Also, it would be of interest to comprehend how you show a 1½ million gain in employment in view of the above published facts, not published by economists.

E. T. TURNEY, JR.
President,
North Shore Nameplate, Inc.,
Bayside, New York

Upon receipt of Mr. Turney's interesting letter, we communicated with our Washington staff economist who reported:

. . . In government, we get our information from economists at the President's Council of Economic Advisers, the Commerce and Labor Departments, the Federal Reserve, and the Joint Congressional Committe on the Economic Report. In industry, our sources include officers of the big banks and economists for large corporations as well as university research people. We correspond with these people or talk to them in person.

I would also like to say that I think our report still stands up very well, fact after fact and figure on figure. I regret only the use of the word "explosive." It was first mentioned to me by an officer of the Chase-Manhattan Bank. But other economists echoed the thought if not the language. I daresay that they would not care to use it today.

Essentially, Mr. Turney makes two points.

(1) That unemployment is widespread. He is correct, of course. But our projection showed that most of the extra production would come from higher productivity, not extra jobs. We looked for an average production index of 145. The index is now up to 142 (from 126 in 1958) and still rising. This forecast is moving along "on schedule." We also said unemployment will fall 1.2 million, but we noted that it would drop slowly. There is little evidence as yet that warrants an apology for this figure.

The cities Mr. Turney cites have had heavy unemployment. But steel production is now over 83% and heading for 90%. And auto sales have shown enough strength to date to warrant optimism for coming months. The sales rate already points to 25 to 30% more volume than 1958—perhaps even more.

(2) That a thumping 8% in growth of the economy seems fantastic. Perhaps it does, but it is proving out nevertheless. Gross National Product—the measure we specifically cited—is now running at an estimated $460 billion a year rate and seems very likely to average out in the $470 billion-plus area we cited. (We based our forecasts on Commerce Department figures showing $440 billion for 1958; this has since been revised down to under $437 billion, so our 8% still seems assured.) Nor have recent gains been due to price changes. Both the consumer and wholesale indexes are now still at their mid-1958 levels.

How then to explain the signs Mr. Turney notes? For one thing, he looks at auto and steel centers—not at the fact that construction is setting records and that soft goods and department store sales are high. (Incomes are up, for those working.) For another, the economy's growth, while developing, isn't great enough to absorb new workers and those displaced by automation. This is the point some congressmen are making in demanding help for depressed areas of substantial and chronic unemployment. We noted this in the Report on Congress in the issue that followed the one Mr. Turney criticized. . . .

We hope that this will serve to answer Mr. Turney's questions.

—Editor.

Write it Down

The editors of ADHESIVES AGE value your opinion. Your communications enable us to prepare a more effective publication. We appreciate your:

- **Comments**
- **Criticisms**
- **Counsel**

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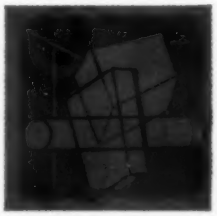

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- **Adhesive Bonding for Fibrous Glass Reinforced Plastics—H. A. Perry. $8.75.** A theoretical and practical manual on the joining of glass reinforced plastics. ☐

- **Adhesives for Wood—R. A. G. Knight. $5.00.** A guide and reference to the problem of joining components together. Considers components made of wood in one of its many forms and the joining of wood to metals and plastics. ☐

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- **Recent Advances in Gelatine and Glue Research —G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Rubber-to-Metal Bonding—S. Buchan. $4.00.** Discusses methods for bonding natural and synthetic rubbers to metals of all kinds, for use by those who manufacture rubber-metal units, and of interest to the rubber-minded engineer. ☐

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- **Adhesion and Adhesives: Fundamentals and Practice—F. Clark, J. E. Rutzler, Jr. and R. L. Savage (Editors). $10.50.** Papers read at a Symposium at Case Institute of Technology and a Conference in London, on the status of knowledge in adhesion. ☐

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THE PRESENT PRICE PLATEAU WON'T LAST LONG, in the view of government statistical experts. The present stability, which began last Summer, will probably continue until mid-summer; any increases or declines in consumer and wholesale prices during this period will be slight. But, as the second half begins, the inflation is expected to make itself felt again.

Today's price stability is partly a result of rapidly rising productivity in manufacturing. For the first time in years, output per manhour is keeping in very close step with rising wage rates. This is helping to hold down unit labor costs. In addition, excess plant capacity is keeping the prices of manufactures competitive. And big crops have held food down.

What will bring the current price lull to its close?

- The productivity surge will slow as another round of wage increases begins and industry gets back closer to capacity.
- A price hike in steel, after wage negotiations, will work itself through to the fabricating and consumer-goods levels.
- An upturn in food prices will be reinforcing other advances.

THERE'S A BIG CHANCE OF A STEEL STRIKE this Summer. Both management and the union have already made it clear that they intend to stand firm in their bargaining. The union reportedly wants a large package, including a 25¢-an-hour wage boost, bigger pensions, more vacation time. The companies insist higher wages will mean higher prices and this, in turn, means a new boost for inflation. They're worried lest customers switch to other metals.

If there's a strike, it will probably start on July 1 and may last as long as two months. If history is any guide, the settlement will give the unions a good part of what they will be asking for. That, in turn, will set the pattern for many other industries. Steel prices may go up about $5 per ton.

WATCH THE FIGHT ON "FEATHERBEDDING" just launched by the railroads. It is being carefully studied by other industries—building, broadcasting, printing, to name a few. The roads' drive aims at cutting costs by ending unneeded jobs and updating antiquated working rules. This would allow cuts in rates to increase competition with trucks and water-carriers. The drive may well set an example that in time will be followed by other industries.

THE 35-HOUR WEEK WON'T BECOME WIDESPREAD for a long time, despite the importance the unions are attaching to it. Labor leaders are seeking a way to create new jobs to help combat unemployment in factories and the growing trend toward automation. Their strategy will be to try first to get Congress to write the 35-hour limit into the Fair Labor Standards Act.

Congressional action would be the short cut that would put the shorter workweek over in a hurry. (Requiring overtime after 35 hours would make it easier for unions to negotiate for fewer hours.) But, while many lawmakers sympathize with union aims, they aren't ready to add to industry's burdens.

THE FEDERAL BUDGET DEFICIT MAY BE LARGER this year than even the huge sum so widely predicted. The President foresaw a red-ink balance of $12 billion at the beginning of this year. Now, it looks as if the deficit will be closer to $14 billion. Tax revenues probably will dip $500 million under estimates. And spending for farm and defense will exceed estimates.

SMALL BUSINESS FIRMS WILL BE GETTING MISSILE CONTRACTS in considerable volume before too long. Up to now, the big companies have gotten the bulk of government work, most of which was research and development. Only the big firms are set up to do this kind of contracting. Now, with production on the rise, the big firms will be in a position to subcontract more component work.

How can a company find out who the key prime contractors are?

- The Small Business Administration maintains up-to-date lists at its regional offices in the country's leading cities.
- The Association of Missile and Rocket Industries also keeps such a list and also keeps a file on firms seeking missile work. It's located in the National Press Bldg., Wash. 4, D.C.

THREE RECENTLY PUBLISHED GOVERNMENT PAMPHLETS that you may find helpful in business: (All agencies offering them are located at Washington 25, D.C.)

- "Starting and Managing A Small Business of Your Own" gives expert advice and costs 40¢ at Government Printing Office.
- "Foreign Purchasing Agents" is a directory listing addresses in the U.S. It costs 10¢ from the Bureau of Foreign Commerce.
- "Products List Circular" reports on inventions for sale or lease. It's free from the Small Business Administration.

A NEW SOURCE OF HELP FOR SMALL BUSINESSES in solving management and research problems is now available—free of charge—from the Small Business Administration. The agency has set up a special division with its own staff to make studies of difficulties most common to broad groups of small firms.

THE FIRST SMALL BUSINESS INVESTMENT COMPANIES are now getting going, preparing to process initial loan applications. The Small Business agency has approved licenses for a score of these new-type lenders, who will be providing capital for growing firms. SBA can tell you where to get a loan.

The loans carry terms like these:

- Amount of any loan is limited to 20% of a lender's capital. By law, that capital will be a minimum of $300,000. But, many loans will be for less—$20,000, $10,000, or smaller.
- Duration may be indefinite, since the lenders will be taking debentures and converting them into stock in the borrower.
- Interest can go as high as the top allowed by your state.
- Purpose may be extra plant, machines, working capital, etc.

Beyond this, borrowers must be able to show adequate assets, good character, business experience, and legitimate purpose.

WASHINGTON DOESN'T EXPECT TENSION TO EASE in the Cold War with the Russians this year. As officials at the State Department see it, the Reds feel that their growing strength makes it unnecessary for them to yield on anything. Our diplomats fear a serious clash—possibly over West Berlin.

• The English trade press has pointed out that preliminary figures for 1958, released by the Board of Trade, show that sales of plastics materials were only 3 per cent higher than those of 1957. The most noticeable change during the year was in the field of thermoplastics, where considerably increased competition, particularly from Japan and Italy, has been experienced.

In the meantime, stocks of thermoplastic materials continue to increase and although sales of PVC, for instance, are slightly over those of the previous year, results are disappointing. It is believed that some of the manufacturers of thermoplastics are considering making an application to the Board of Trade for the imposition of higher tariff rates on these materials. However, no definite decision has been reached.

• Finished plastics goods imported by Western Germany amounted to approximately 235 million DM ($56 million) during the first nine months of last year. In 1957, Germany imported merchandise amounting to 182 million DM ($43 million) and during the previous year, imports amounted to 128 million DM ($35 million).

• The formation of a new Belgian company, Cobenam, S. A., for the manufacture of polyethylene, has been announced by M. G. Dial, chairman of Union Carbide Corp., New York, N. Y. The new company will be owned jointly by Union Carbide and Societe Chimique des derives du Petrole, S. A., Petrochim. Petrochim is an affiliate of Societe Generale, and other important Belgian financial groups.

Plans call for the construction of a plant having an initial capacity of 30 million pounds of polyethylene annually, with production estimated to begin in mid-1960. The plant will be located near Antwerp between the Petrochim chemical plant and the Societe Industrielle Belge des Petroles (SIBP) refinery. Raw materials will come from SIBP, while technical "knowhow" will be provided by Union Carbide. Cobenam, S. A., will represent the third Union Carbide investment in European polyethylene production facilities.

• When latex comes in contact with a porous surface, gelification of the rubber is produced on this surface as a result of the absorption of the dispersal medium. The quantity and speed of gel formation increases with the concentration and temperature of the latex. According to a Russian authority, the close contact between the globules during dehydration is the cause of a partial destabilization and of gel formation.

• Studies on low pressure polyethylenes have been undertaken in Germany. In these studies, polyethylenes prepared by normal pressure in the presence of catalyzers of organo-metallic type have been separated by fractionated precipitation. As a result, the function of distribution of long chains have been determined.

It appears that the functions of these polymers are similar and that all polyethylenes having the same intrinsic viscosity show distribution functions of an identical type, regardless of the method of preparation. The maxima of the distribution functions are situated in the weakest zone of polymerization.

• More precise names for new compounds are called for in an article appearing in a British publication, which complains about some of the new terms relating to new compounds. The author dislikes the term "synthetic natural rubber" as a long-term designation, but admits that at present there is no fully satisfactory substitute term.

"Isoprene-derived synthetic rubber" or "synthetic-isoprene-derived rubber," although possibly more correct, sound a bit long-winded. The author is not convinced that a term including the word "natural" is quite satisfactory, but until a better expression is introduced, it will have to be used.

• The eighth and latest instalment of the "Dechema-Werkstoff-Tabelle" has been released. The publication consists of 100 pages of precise data on the chemical resistance of about 100 constructional materials to 46 corrosive substances. "Dechema-Werkstoff-Tabelle" will ultimately consist of a total of 1,200 pages, of which 800 have already been published. Single pages are not supplied. The complete work, in consecutive page number, is obtainable from Dechema, Frankfurt/Main 7, Postfach.

• Reserve rooms right now if you plan to attend the Kunstoffe Exhibition which will take place in Duesseldorf on October 17 to 25. The secretary of the British Plastics Institute reports that he had great difficulty in securing suitable accommodations for the 70 members who will visit the Plastics Exhibition.

It seems that the entire plastics world will have a rendezvous in Duesseldorf and any prospective American participant should make immediate arrangements. However, Duesseldorf is surrounded by a number of very attractive cities and those who do not mind a short ride or drive will certainly be able to locate suitable hotel accommodations nearby.

On the Continent

• A new range of hardeners for epophen epoxide resins was introduced about a year ago. These hardeners are said to greatly reduce the hazards of toxicity and dermatitis which are usually associated with epoxide resin/hardener combinations. Further development work has shown that the new hardeners also have other advantages. The heat resistance and impact strength of the cured epoxide resin are improved; there is less variation in gel time with change in temperature; there is less need for precision in measuring hardener in proportion to resin; and the resin/hardener mixture has the ability to set under damp conditions without significant loss of strength.

In ordinary adhesive work with the resin/hardener mixtures, it is unnecessary to protect joints from excessive atmospheric humidity while the resin is setting. Moreover, the resistance to humidity is such that a casting, laminate or adhesive bond can be made with normal dry ingredients and surfaces and then be immediately immersed in water without the loss of more than about 10 per cent of its maximum strength.

• The German press is enthusiastic about the progress of American adhesives. The following item appeared in the German daily paper, "Dillpost," published in Wetzlar. "American experts are of the opinion that we will replace nails, screws, rivets and even welding by adhesives. Chemists are already busy preparing entire groups of new compounds which have an adhesive force which cannot be overcome by a solvent or by breaking. In the near future they will use adhesives when manufacturing cars, ships, machinery and technical installations."

• A laboratory will be constructed by the American Cyanamid Co., New York, N. Y., in Geneva, Switzerland. The company recently announced that it has completed plans for a million dollar basic research laboratory, which will be called Cyanamid European Research Institute, Inc.

The new scientific center will be devoted to long-range research in the chemical and biological sciences and will serve primarily as an idea center. A small staff of top-notch European scientists will be appointed to the laboratory and will pursue their investigations without restrictions.

• Trade Missions of the United States Department of Commerce will visit France, Germany, Morocco, Spain, Nigeria and Poland. The United States Department of Commerce has already been quite successful with its trade missions to New Delhi and Northern India. A mission will stay in France from March 31 until May 15 in order to visit Paris and a number of other French trade and industrial centers and Germany will be visited by another trade mission which will stay in that country from March 30 to May 9, 1959. The American delegation will attend the Hanover Germany Industries Fair which will be held from April 26 to May 5. Other missions to Morocco, Spain, Nigeria and Poland are scheduled to take place between April and June.

The missions have been very successful in the past in initiating and negotiating licensing arrangements with local companies in behalf of American manufacturing concerns. They are willing, for instance, to locate firms in the various countries which are interested in new processes or in manufacturing United States products under licensing agreements. It could also include establishment of contacts with foreign firms which would like to license their technique to American companies.

Any company which wishes to develop or expand its business through trade with and/or investment in France, Germany, Morocco, Spain, Nigeria and Poland is invited to make its interest in these areas known to the Trade Missions Division of the Bureau of Foreign Commerce. In order to start the necessary procedures, a letter, in triplicate and on business letterhead, should be addressed to the attention of E. Paul Hawk, Director, Trade Missions Division, Room 1856, Bureau of Foreign Commerce, U. S. Department of Commerce, Washington 25, D. C.

• A German company, Kautschuk-Gesellschaft, G.m.b.H., Frankfort/Main, Reuterweg 14, has advertised a new adhesive in the English trade press. The firm uses the trade mark "Megum" (a combination of the two words metal and gummi), and the generic term "Haftmittel." It seems that the German copywriter wanted to impress the English audience by including the German word in the British copy. The English language has quite a number of good substitutes or translations for the German word which simply means adhesives.

• Dr. W. Hechelhammer, of the German Bayer Farbenfabriken, recently addressed a meeting of the British Plastics and Polymer Group of the Society of Chemical Industry, on the subject of polycarbonates. This was the first time that the new polymer was described in England. Polycarbonates are made by reacting p-p-dihydroxy diaromatic compounds with carbonic acid derivatives. For instance, the reaction of diphenylopropane (bisphenol A) with carbonyl chloride or p-p-dihydroxy diphenylmethane and diphenyl carbonate.

Products with a molecular weight in excess of 200,000 can be made, and are known as "Makrolon" or in the cast condition as "Makrofol." Polycarbonates can be used up to 120°C; become thermoplastic at 200°C.; and decompose between 310°C. and 340°C. The materials show great dimensional stability and could be heated to nearly transition temperature (second order transition at 140°C.) without dimensional change for long periods. For a thermoplastic it shows excellent tensile (about 10,000 psi) and flexural strengths.

The stress strain curve shows long elongation and only minor cold flow. Impact strength is high and elongation at a stress of 3,500 psi after one year was still zero. The materials have about the same chemical resistance as that of polystyrene but do not have the universal resistance characteristic of polyamides.

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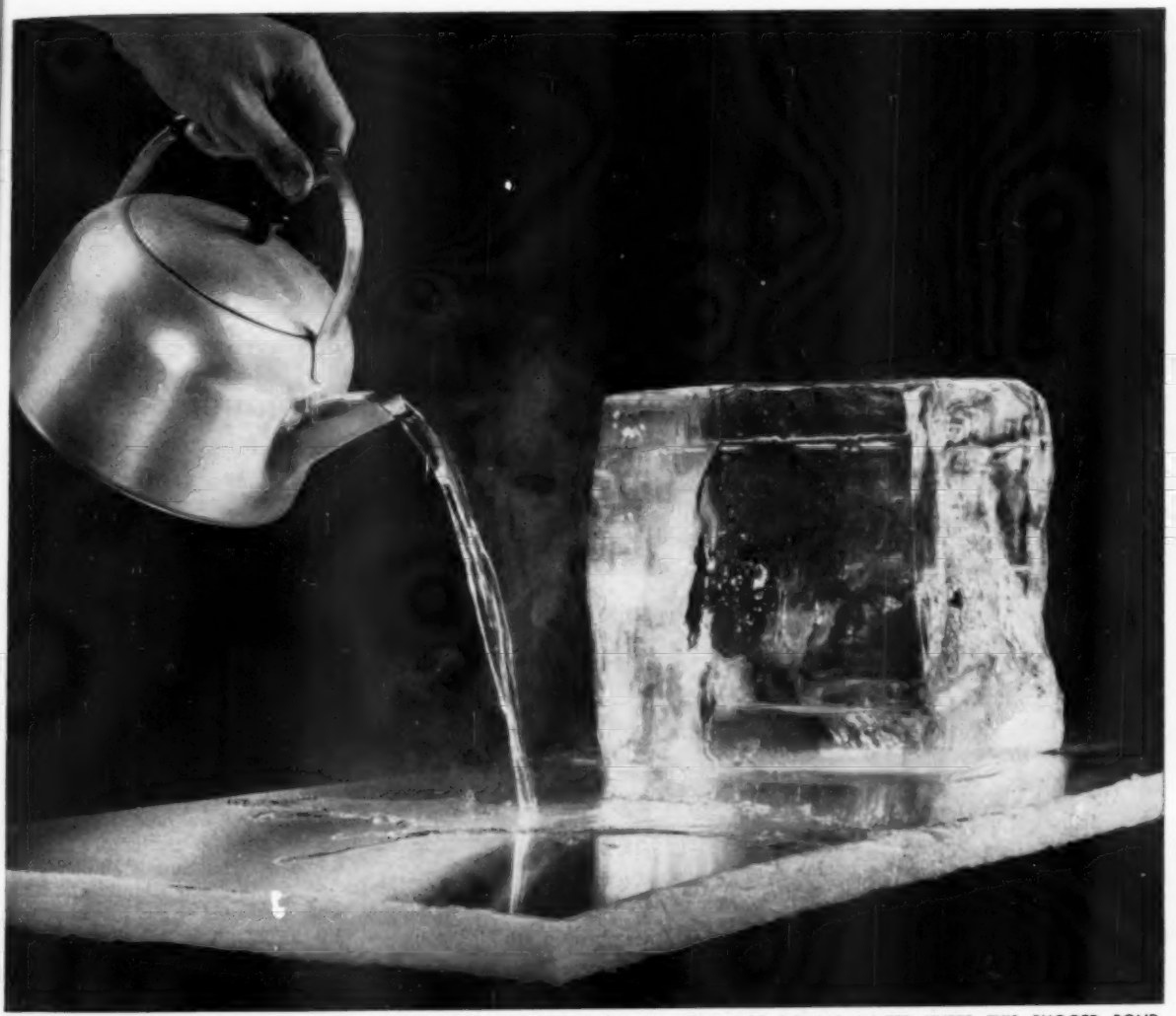

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Epoxy Bonding

Semi-automated adhesive bonding system speeds the production line at North American Aviation

In the early 1950's, North American Aviation was faced with a difficult decision—the selection of a structural adhesive system for high-volume bonding of supersonic aircraft assemblies. In those days, long before the advent of epoxy-phenolic composite films and one-part epoxy paste adhesives, our choice was limited to either a modified phenolic film or a catalyzed epoxy paste adhesive system.

Although industry surveys revealed that all major bonding shops were successfully employing either vinyl- or nitrile-modified phenolic film adhesives, several unusual advantages of the epoxy paste adhesives could not be overlooked. First, epoxy adhesives are completely non-volatile and, consequently, emit no troublesome gaseous products during cure. Second, epoxies exhibit excellent filleting properties in honeycomb bonding and, third, epoxies require only contact pressure during cure for optimum bond strength. On the basis of these three interesting properties, North American chose the epoxy system.

We were well aware, however, of the many problems associated with volume usage of an adhesive of this type. We realized that our bonding shop would complain bitterly about handling a high viscosity paste adhesive. Furthermore, their problems would be aggravated by the short pot life of a catalyzed adhesive system. We also realized that immediate action would be required to protect our shop personnel from the dermatitis generally associated with the manual handling of amine curing agents.

Unfortunately, our problems were not restricted to handling. On the more serious side, we were faced with an adhesive with inherenty low peel strength and relatively poor salt spray and humidity resistance.

Our laboratory was assigned the seemingly monumental task of quickly solving these problems and providing our shop with a practical epoxy bonding system.

Automatic Handling

Automation proved to be the answer to our handling problems. A series of unique handling equipment was developed to eliminate the human element from the adhesive preparation phase of our epoxy bonding process. For example, a simple machine automatically extrudes the uncatalyzed epoxy paste adhesive from our supplier's five-gallon pails into special disposable quart cans. An electronically actuated double action valve cuts the ribbon of adhesive when the quart can is filled to desired weight.

The next step in our adhesive preparation consists of proportioning catalyst into the adhesive. This phase is handled by an automatic catalyst dispenser which is based upon the principle of positive displacement. It automatically and accurately dispenses the correct proportion of catalyst regardless of the weight of adhesive involved.

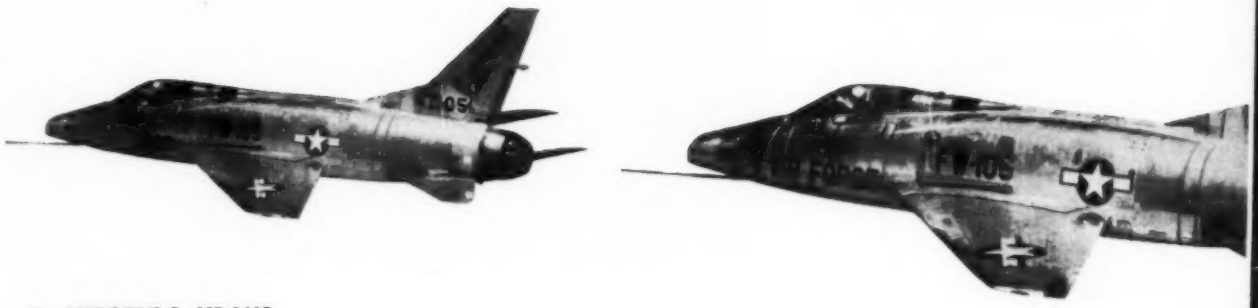
Operation of the unit is simple. The can of uncatalyzed adhesive is merely placed on the weighing pan and the "on" switch pressed. The flow of catalyst stops when the correct proportion of catalyst is reached, and the catalyst can then be poured into the adhesive.

The next step required a means of quickly and uniformly blending the catalyst into the adhesive. For this operation, we came up with automatic mixing machines. Their principle of operation is similar to that of an old fashion butter churn. A perforated steel disc is forced vertically through the adhesive. After approximately 100 strokes, the catalyst is uniformly blended into the adhesive.

A complete mixing cycle takes about one minute. A minimum of exotherm and entrapped air is generated in this machine mixing operation. At North American, we color our catalyst with a controlled addition of a brightly colored inert pigment in order to visually indicate uniform blending of catalyst and adhesive.

Immediately after the mixing operation, we must quickly convert the bulk catalyzed adhesive into a scrim supported adhesive film. A machine driven adhesive spreader developed specifically for the preparation of epoxy film adhesive handles this operation. This adhesive spreader is similar in principle to the

# of Aircraft Structures



By HERBERT S. KRAUS
Section Leader, Plastics & Bonding
Production Development Laboratory
North American Aviation, Inc.
Los Angeles, California

doctor-blade used in paint laboratories to lay down a paint coating of controlled thickness. However, unlike the doctor-blade which is drawn across the surface to be coated, the blade in our adhesive spreader is stationary.

The fabric scrim (over a thin film of polyethylene) is drawn through the controlled gap between the blade and the blade platform, thus depositing a uniform film of adhesive on the scrim. Adhesive film is prepared in widths up through 36 inches at a rate of 20 feet per minute.

An interesting feature of this spreader is its versatility in producing adhesive films of any desired thickness. By simple shim adjustment, the gap between the blade and the blade platform can be varied to produce the optimum adhesive thickness for the honeycomb core to be bonded.

This semi-automatic preparation of adhesive not only solved our epoxy handling problems, but also did much to alleviate the anticipated problem of mass dermatitis in our bonding shop. By removing most of the human element from the handling of amine curing agents and enforcing a strict program of personal hygiene, the occurrence of dermatitis in our bonding shop has been practically eliminated.

Rapid adhesive preparation also minimized the problem of limited pot life. The tape is prepared on order when bonding details are ready for assembly. It is carefully positioned wrinkle-free on the part facing, trimmed, the polyethylene film stripped from the adhesive tape, and the part assembled.

The assembled part is placed on a steam heated bonding tool, bagged and autoclave cured. Although the pot life of the epoxy adhesive allows a lapse time of four hours from catalyzation to start of cure, the largest part produced at North American can be processed within two hours.

Clam-Shell Autoclaves

Another interesting feature of the North American bonding shop is the use of multiple clam-shell autoclaves instead of the more conventional large, walk-in cylindrical autoclave. This battery of twelve clam shells, ranging in diameter from 40 to 100 inches, was installed primarily to support bonding with limited pot life adhesives.

Using this individual autoclave system, we are able to cure immediately after assembly. With the large, multiple—part autoclave, it is not economically feasible to start the cure until the autoclave is loaded with a full charge of parts. The individual clam-shell autoclave system has the added advantage of permitting us to select the bonding pressure best suited to the individual part.

For example, the compressive strength of very light honeycomb core normally restricts bonding pressure to 30-50 psi. On the other hand, heavier parts with compound contours may require 70-80 psi to ensure intimate contact of all details. It is, therefore, impossible to properly bond these varying parts simultaneously in the same autoclave. It should be pointed out that each clam-shell is equipped with an electronic control console which automatically programs and records both the temperature and pressure of each cure cycle.

Improving the peel strength and the salt spray and moisture resistance of epoxy bonds did not prove to be an especially difficult assignment. Since it did not seem advisable to alter the basic formulation of the epoxy adhesive—and thus jeopardize its inherent excellent shear and tensile strength properties—our laboratory conceived the idea of complementing the epoxy adhesive with a compatible yet chemically dissimilar adhesive primer.

Fortunately, this dissimilar priming proved to be the common solution to our peel, salt spray, and humidity problems. Initially, we were moderately successful in utilizing as a primer the liquid counterpart of commercially available vinyl modified phenolic film adhesive. Complete success was not achieved until our adhesive supplier developed a unique epoxy-phenolic-elastomeric primer specifically designed as a precoat for epoxy bonding.

In production priming, a 0.7 to 1.0 mil pre-coat is spray applied to all freshly cleaned metal adherends, including honeycomb core. Unlike

Mechanized Four-Step Preparation of Epoxy Adhesive

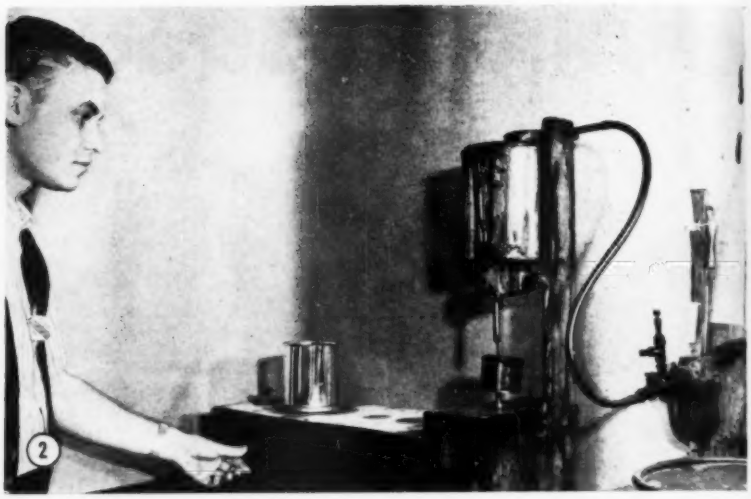


FIG. 1—Uncatalyzed epoxy paste is extruded from five-gallon pail into disposable can. Adhesive flow is cut automatically when desired amount is drawn.

FIG. 2—Based on positive displacement principle, the dispenser unit automatically releases correct proportion of catalyst for the amount of adhesive involved.

FIG. 3—Automatic mixing machine blends the catalyst into the adhesive by means of a vertically driven perforated steel disc. About 100 strokes are required.

FIG. 4—Doctor-blade on machine driven adhesive spreader automatically lays down an epoxy film on a fabric scrim moving at rate of 20 feet per minute.

Bonding of Assemblies for Supersonic NAA Aircraft

FIG. 5—Epoxy paste adhesive tape, prepared on order when parts to be assembled are ready for bonding, is positioned wrinkle-free on the part facing.

FIG. 6—Once the adhesive lay-up has been positioned on the part, it is trimmed to size. Pot life of the adhesive is four hours from catalyzation to start of cure.

FIG. 7—The polyethylene film is stripped from the adhesive tape and the aircraft part is ready for assembling. Notice the use of gloves to protect operator.

FIG. 8—North American's battery of clamshell autoclaves range in size from 40 to 100 inches. Use of individual autoclaves permits immediate assembly cure.

Table I—Metal-to-Metal Bond Data Per Specification MIL-A-5090B

Test	*Results*	*MIL-A-5090B Requirements*
Standard Temperature Shear Strength	3770 psi	2500 psi (minimum)
180° F. Shear Strength	3366 psi	1250 psi (minimum)
–67° F. Shear Strength	3173 psi	2500 psi (minimum)
Standard Temperature Creep-Rupture Strength (Deformation)	No failures 0.0008 in.	0.015 in. (maximum)
180° F. Creep-Rupture Strength (Deformation)	No failures 0.0005 in.	0.015 in. (maximum)
Standard Temperature Bend Strength	189 lbs.	150 lbs. (minimum)
30 Day Salt Spray Shear Strength	3210 psi	2250 psi (minimum)
30 Day Water Immersion Shear Strength	3200 psi	2250 psi (minimum)
7 Day Immersion in Anti-Icing Fluid	3739 psi	2250 psi (minimum)
7 Day Immersion in Hydraulic Fluid	3754 psi	2250 psi (minimum)
7 Day Immersion in JP-4	3653 psi	2250 psi (minimum)
7 Day Immersion in Hydrocarbon Fluid	3834 psi	2250 psi (minimum)

Table II—Metal Sandwich Bond Data Per Specification MIL-A-25463

Test	*Results*	*MIL-A-25463 Requirements, Type 1*
Normal Temperature Peel	21.8 in.lbs./in.	8.5 in.lbs./in. (minimum)
180° F. Peel	21.5 in.lbs./in.	5.0 in.lbs./in. (minimum)
–67° F. Peel	7.2 in.lbs./in.	2.0 in.lbs./in. (minimum)
Normal Temperature Flatwise Tension	1500 psi	450 psi (minimum)
180° Flatwise Tension	940 psi	270 psi (minimum)
–67° F. Flatwise Tension	1250 psi	350 psi (minimum)
Normal Temperature Flexural	2610 lbs.	1750 lbs. (minimum)
180° F. Flexural	2540 lbs.	1200 lbs. (minimum)
–67° F. Flexural	2620 lbs.	1750 lbs. (minimum)
Flexural After 15 Days Exposure to 100% elative Humidity at 165° F.	2740 lbs.	1500 lbs. (minimum)
Flexural After 30 Days Exposure to Salt Spray (QQ-M-151)	2510 lbs.	1500 lbs. (minimum)
Flexural After 30 Days Immersion in Hydrocarbon Fluid MIL-H-3136, Type III	2570 lbs.	1500 lbs. (minimum)
Creep Deflection After 800 lbs. Loading for 4 Hours at 180° F.	0.004 in.	0.100 in. (maximum)

conventional primers for phenolic bonding, this modified epoxy precoat is fully cured at 330-340° F. prior to the bonding operation. After cure, these primed details may be stockpiled indefinitely for subsequent use. Immediately prior to bonding, all primed surfaces, except core, are subjected to a thorough double hand cleaning with solvent (toluene) to remove contaminants that may have collected on bonding surfaces during handling subsequent to the priming operation.

The Los Angeles Division of North American Aviation has fabricated over 150,000 epoxy bonded primary and secondary aircraft structures. Our experience through these past years with epoxy bonding has brought out numereous advantages that are not common to most conventional film bonding systems.

(1) Probably the most important advantage of the North American epoxy bonding system is its excellent "balanced" physical properties. It is rather unusual to find an adhesive system with high peel strength coupled with excellent elevated temperature creep resistance, since flexibility and creep resistance are normally not synonymous. Tables I and II represent typical bond strength data developed in our laboratory for both metal-to-metal and metal sandwich joints. In Table I it may be noted that all lap shear values exceed 3000 psi regardless of exposure condition and test temperature.

(2) Epoxies are insensitive to normal variations in ambient temperature and relative humidity in the bonding shop. Consequently, expensive atmospheric control during adhesive preparation and assembly is not required for optimum bond strength.

(3) Epoxies are equally suited for both metal-to-metal and metal sandwich bonding.

(4) Bulk epoxy adhesives are ideally suited for core splicing, insert bonding and core edge to close-out bonding. The use of one basic adhesive for all bonding operations eliminates the need for multiple cures in the fabrication of complex bonded assemblies.

(5) The use of epoxy adhesive is not limited to aluminum bonding. It is also an excellent structural bonding agent for other rigid materials such as steel, glass, wood, and reinforced polyester, epoxy, phenolic, melamine, etc.

(6) Epoxy bonds exhibit unusually high reliability. Noticeable variations in catalyst content, glue line thickness, bonding pressure, and curing time have little or no apparent adverse effect on bond strength. This fact was demonstrated in our laboratory when we unsuccessfully attempted to produce substandard bonds. Even drastic contamination of the adhesive with sizeable quantities of oily sweeping compound failed to weaken the bond.

(7) Epoxy adhesives offer a choice of temperature resistance merely by the selection of curing agent. At North American, we use an aliphatic primary amine for optimum strength in the temperature range of —67 to 180° F. This adhesive system is cured at 250° F. An aromatic diamine curing agent is used for optimum strength in the temperature range of —67 to 260° F. and intermittently to 300° F. This adhesive system is cured at 330° F. Both catalyzed adhesive systems are used with the same primer. It is interesting to note that both epoxy adhesive systems have been officially qualified by the Air Force to Specification MIL-A-5090B and both completely conform to the requirements of Specification MIL-A-25463, Type 1.

NOTE: All specimens for tests of metal-to-metal and metal sandwich joints were primed with Bondmaster M-602 and bonded with Bondmaster M-611 epoxy adhesive. Bondmaster products are manufactured by the Rubber and Asbestos Corporation, Bloomfield, New Jersey.

About the Author . .

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Bonding Wood With the Oldest High Polymer

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This is an article about animal glues and it may be surprising to see these so-called "natural" adhesives referred to as high polymers. Actually, many of the recently developed synthetic adhesives have chemical structures that are comparatively simple when compared with those of protein derived adhesives.

Many of the unique properties of animal glue are directly due to its being a high polymer of exceedingly high molecular weight—estimated at 38,000 or more. The basic building blocks or monomers making up this large molecule are known as amino acids. These amino acids are fairly complicated organic chemical compounds themselves and a single protein or animal glue molecule contains about 288 amino acids of at least 14 distinct types.

Perhaps we are inclined to take animal glues for granted because they have been established in use for so many years. Nevertheless, due to their chemical complexity, they more than rival in properties many of the newer yet actually much simpler synthetic high polymers.

Although animal glues are presently used for many modern and unusual applications such as uranium processing and modern explosives manufacture, their primary use is still as adhesives. In particular, their unusual combination of properties make them virtually irreplacable as the classical wood adhesive.

The durability of furniture bonded with animal glues may be considered to be virtually infinite under ordinary conditions of use. This is important since the average purchaser expects high quality furniture to be a permanent possession and in many cases even to be passed down to the following generation. Needless to say, there is much evidence of this durability existing today as priceless antiques in museums all over the world.

Unusually high strength in wood-to-wood bonds is another of the outstanding properties of animal glues. Under proper conditions of application, bond strengths that exceed the strength of the strongest wood may be routinely expected in commercial furniture gluing operations, and once strong bonds are made their high strength can be expected to endure as previously described. This unusual strength is related to the large size and many active groups of the animal glue molecule.

Getting the Best

Most plants manufacturing high quality glued wood products are agreed that the best adhesives are cheap at any price. However, using animal glues it is actually possible to obtain bonds of maximum strength and high durability at unusually low cost.

Because animal glues are unusually high molecular weight polymers, they exist not in true water solution but rather in a colloidal state when combined with water. This colloidal state has two phases, namely the sol and gel forms. The relationship between these two is completely reversible with heat so that when cool the dispersions are gelled but may be easily remelted by heating to about 90-100°F.

This property is used in woodworking by applying animal glue solutions hot just before assembling the spread surfaces. The almost immediate gelling that takes place upon slight cooling forms a very rapid temporary bond which soon becomes permanent when the glue film dries.

The versatility of animal glues is another reason for their wide use in modern wood gluing. Since they are easily mixed, these adhesives are usually prepared in the user's plant. Because of this, concentration and viscosity may be controlled to fit any given type of application or production condition. This may vary from the very dilute solutions used for sizing face veneers prior to finishing, to heavy concentrations used for edge gluing under conditions of short assembly times and high room temperatures.

Animal glues for modern woodworking are furnished in two main types: the standard dry glues which are mixed prior to using hot, and the ready-to-use liquid types. Of the three classes of dry glues available—hide, extracted bone, and green bone—hide glues are used almost entirely in furniture construction because they are the strongest and most reliable.

Prepared liquid animal glue is

made from hide glue by the addition of chemicals which prevent the glue from gelling at room temperature. This type of adhesive, when properly manufactured, sacrifices none of the high strength characteristics of hide glue and has a great many uses. Among the most important applications are those requiring considerable assembly time before clamping or pressing. Prepared liquid animal glue is also used where equipment is not available for hot glue preparation.

One of the most popular misconceptions about liquid animal glues is that they are very slow setting. While this was true of some early products, and in isolated instances may still be so, high quality liquid animal glues set very rapidly and are adaptable to many high speed operations.

The majority of modern furniture plants today use animal glue as the standard adhesive for the assembly of cases, drawers, chairs, frames, etc. Acceptance of this 3000 year old adhesive does not mean that these furniture manufacturers are not progressive. On the contrary, it indicates that properties such as rapid set, high bond strength, reliability and low cost are even more important today, when competition is keen and high production as the lowest possible cost consistent with high quality is a necessity.

Much edge gluing of core stock and solid tops is also done with animal glues on clamp carriers. This includes the high volume producer of dimension stock who must produce the unusually high quality edge glued stock used in finished furniture and other wood products.

One of the most efficient methods of producing laminates for posts, legs, and other stock to be turned or carved is by the use of the clamp carrier and either hot or liquid animal glues. Where high jaws with top and bottom clamps are used, the high uniform pressure necessary to secure good contact with heavy stock of this type is easily obtained. More satisfactory laminates of better bond strength seem to be produced in this manner than by the method of cold pressing a large number of stock pieces and then baling. This is true mainly because it is very difficult to get the intimate contact between all pieces in the bale necessary for thin uniform glue lines.

Wood Sizing

One of the least publicized uses of animal glue is in the sizing of wood prior to finishing. This neglected art is of great value in producing a uniform and smooth surface for succeeding top coats. Glue sizing is particularly important prior to finishing fuzzy woods such as mahogany.

When applied prior to the final white sanding, the glue size raises and stiffens the fibers that have been formed in previous sanding so that they may be cut cleanly and leave a very smooth surface. If done properly, sizing also has a sealing effect which makes uniform staining much easier by increasing hold-out.

The sizing solution is ordinarily a 7-10 per cent solution of a good grade of dry animal glue and may be applied at about 105°F. with a sponge, brush, sprayer or roll spreader. Drying may be accomplished either at room temperature or by forced drying.

Hot animal glues generally do not allow adequate assembly time for exceedingly long laminates or those with a very large number of pieces. In such cases, this stock may be very satisfactorily glued by the use of liquid animal glues or by modifying the ordinary hot glue with 5-10 per cent of the chemical thiourea.

One of the newer uses of liquid animal glue is in the panel-on-frame bonding of cabinet ends and tops. While this application is at present largely restricted to television and hi-fi cabinet manufacture, there are similar operations in the case goods field. Generally, a progressive pressing technique utilizing a large number of low cost homemade air presses is used.

These presses often utilize fire hose to apply pressure. A sufficient number are in operation so that an empty press is always available for the load being laid up. The continuous output from such a system results in high production of cabinet sub-assemblies of excellent glue bond quality. While veneer panels are used in some of these operations, hardboard, later to be grained, is used in the majority of them.

Plants gluing large quantities of tempered hardboards by this method have found a light scuff sanding, to remove any excess tempering oils from the board surface, an important aid to consistently high glue bond quality.

As has been shown, operations requiring a long closed assembly time, quite naturally dictate the choice of liquid animal glues. However, the basis for selecting the correct dry animal glue test grade has often been misunderstood in plants using wood.

In this respect, there has been a tendency to select the highest test grade available in the belief that it will provide the strongest bond. However, standard ASTM block shear tests, as well as other tests, have shown that the strength of all standard grades of hide glue is well in excess of 3000 psi in shear and far exceeds that of our strongest species of wood.

Since all the standard hide glues have more than adequate bond strength, selection of the proper animal glue for wood gluing cannot be made on this basis. However, since these test grades do vary in their rate of gelations, the proper grade is chosen on the basis of the assembly time employed in a particular operation.

The use of extremely high testing

Unit for continuous ripping, jointing and edge gluing lumber at Gamble Brothers, Inc., Louisville, Ky. Animal glue plays an important role in material for the furniture trade

grades is important in a few specialized operations where rapid gelling of the glue is of major importance. Where these grades are used in operations for which they are not specifically required, the common reaction is to excessively dilute them to offset their very rapid gelling characteristics. However, the use of such dilute solutions in operations where high pressures are employed, such as edge gluing, usually results in starved joints and weak bonds due to excessive penetration of the glue solution.

In order to use animal glues to their best advantage in woodworking, some knowledge of why and how they adhere to wood is a necessity.

One of the most common misconceptions about animal glues is that they must thoroughly penetrate and impregnate the wood adjacent to the glue line in order to produce tendrils or hooks of glue that will mechanically attach the glue to the pores of the wood. In an attempt to achieve this penetration—and subsequent mechanical adhesion—it is common practice to use a thin glue, heat the wood, and apply high pressure to force the glue to penetrate deeply into the wood pores.

These practices do not result in high-strength wood bonds but in starved joints which are weak and show little failure in the wood when broken. If penetration into the pores of the wood were a prerequisite to strong glue bonds, it would not be so difficult to obtain strong end grain (butt) joints, especially without sizing to fill the pores prior to gluing.

It should also be pointed out that conifers such as white pine and redwood are nonporous woods, and yet they are very easily glued. Glass with its smooth indisputably nonporous surface can be easily glued with animal glues, and bonds so formed will fracture the glass when tested to failure. Since animal glue forms strong bonds to nonporous materials or to filled porous surfaces, ti must be concluded that electro-chemical attraction between the molecules of glue and wood is actually the basis for strong glue bonds.

This attraction, known as specific adhesion, is of a very high order between wood surfaces and animal glue. It is brought about because the very large animal glue molecule contains a great number of readily available and highly polar amino and carbonyl groups which exhibit a strong affinity for the hydroxyl groups contained in the wood. Maximum strength of adhesion is obtained by forming a thin but completely continuous glue film between the wood surfaces. This presents the largest possible integral glue line and thus, the greatest amount of attractive forces between the glue and wood are built up.

Water-Glue Ratios by Weight for Rapid and Slow Assemblies Under Normal Temperature and Pressure

Peter Cooper Glue Grade	*Rapid Assemblies (0-15 seconds closed)*	*Slow Assemblies (1 minute closed)*
A Extra	2-1	2 ¾-1
1 Extra	1 ⅞-1	2 ½-1
1 Extra Special	1 ¾-1	2 ¼-1
# 1	1 ⅝-1	2 ⅛-1
1XM	1 ½-1	2-1
1X	1 ⅜-1	1 ¾-1
1 ¼	1 ¼-1	1 ⅝-1
1 ⅜	1 ¼-1	1 ½-1
1 ½	1 ⅛-1	1 ¼-1

Concentration—In order to obtain the required thin but continuous glue film when the wood assembly is pressed, the glue must be of the proper consistency. The proper glue concentration for a particular operation is dependent upon the following factors.

(1) Assembly time
(2) Wood and room temperature
(3) Glue temperature
(4) Pressure

Suggested Concentrations

Showing various grades of Peter Cooper glues as an example, the accompanying table gives suggested glue concentrations for two commonly used assembly times at normal temperatures for wood and room (70-75°F.) and glue (145°F.). The pressure used (150 psi) is approximately that usually obtained on clamp carriers. Where spreader evaporation rates are high it may sometimes be necessary to slightly increase by about ¼ the proportion of water in ratios shown for rapid assembly times.

To achieve optimum bonds where wood and room temperatures are higher than normal, a longer closed assembly time may be allowed. If this is impossible from a production standpoint, the amount of water in the glue mix must be reduced.

For example a 1 Extra Special Grade at 2¼-1 requires approximately ½-1 minute closed assembly time to produce the best bonds where wood temperature is 70°F. Under the same conditions, 3-5 minutes is required at 80°F. and 10-18 minutes at 90°F. Since the last two mentioned closed assembly times are usually far too long to be practical, high production with the short assembly times needed may be obtained by decreasing the water to obtain concentrations as shown in the left hand column of the table, or lower if required.

Mixing—Once the proper glue concentration for the particular operation has been selected, it should be held constant by a careful mixing procedure. The dry glue should always be weighed and not measured since variations in particle size may give varying net weights for the same volume. It is often found that weighing the water is a simple and precise procedure, although measurement by volume may be used if the container has been carefully calibrated and is re-checked at frequent regular intervals.

Soaking—Following careful measurement of the correct proportions of glue and clean cool water, the glue is added to the water and thoroughly mixed until entirely wet out. Special clean covered pails or tubs may be used for the soaking procedure, or if a storage tank is available for the previously melted glue, soaking may take place in the melter itself with no application of heat.

Melting—Following soaking for one-half to one hour, or until the glue has become thoroughly swollen, it is melted at 145°F. Although this procedure is often referred to as "cooking," only enough heat with agitation is required to form a smooth solution. Once the glue has

reached this state it is ready for use at 140-145°F.

The proper equipment for glue melting is an agitator equipped water jacketed mixer. Heat may be applied to the water jacket by electricity, steam or gas. It is most important, regardless of the method of heating used, that the glue temperature does not rise above 150°F. (preferably 145°F.). An accurate thermostat is a necessary requirement to protect the glue against overheating.

Any of the commonly used machines for wood surfacing—excluding sanders—are satisfactory for preparing wood surfaces for gluing with animal glues. Straight-line rip saws and, less commonly, jointers are currently used for preparing stock for edge glued panels. Stock for laminates is best prepared by use of the finish planer.

Preparing Joints

Adequate quality in machining assembly joints is of equal importance. If dull bits or other cutting tools are used to prepare these joints, the surfaces will be burnished or slightly burned. Because this treatment chemically alters the surface, no glue will adhere to it.

The allowance of small plus tolerances in dowel holes will be found of great assistance since enough room for the glue to flow around and form a film between the dowel and the hole is a necessity. Tight fitting dowels will not permit a continuous film to form around them and a starved, weak bond will be the result.

If wood is dried to the proper equilibrium moisture content for interior use, no difficulty should be expected in the use of animal glues. The average moisture content that wood attains in interior use is 7-8 per cent. This is, of course, the commonly accepted range for kiln drying lumber prior to processing, and it coincides with the ideal moisture content for the use of these glues.

Animal glues may also be perfectly satisfactorily used in the range of 5-10 per cent wood moisture content. Moisture content lower than 5 per cent is quite apt to produce starved joints because of very rapid absorption. High wood moisture contents may slow down glue setting.

Animal glues may be spread by many different types of equipment. At present, most edge gluing and post laminating operations use roll-type motorized spreaders which are heated by electricity or steam if hot glues are used. These spreaders should be equipped with a doctor roll or blade in good working order so that the spread can be controlled.

The newest development in spreading for high speed edge gluing is a conveyerized spreader used in conjunction with the clamp carrier. While spreaders of this general type have for some time been available for prepared liquid glue use, they are an entirely new development for use with hot animal glues. They are now available fully equipped to maintain hot glues at the proper temperature for efficient use under all production conditions.

Since hot glues are used on almost all clamp carrier gluing operations—initial results have shown production increases of 40 per cent with the same number of man-hours—it is expected that this system will have wide use in wood gluing operations.

Brushes, syringes and especially designed roll or wheel types of spreaders are used for the various types of assembly joints. Glue guns, in which the glue is forced by compressed air through a hose to the applicator, are an efficient way of spreading liquid animal glues. Especially designed toothed wheels are usually employed to spread dovetails prior to drawer assembly.

Although considerable care is usually taken in spreading liquid animal glues, perhaps because of their higher cost, it is common practice to spread hot animal glues in excessive amounts. This practice is, of course, uneconomical and may cause production difficulties because heavy spreads gel more slowly and remain thin in consistency longer. Under these conditions, when pressed the glue will both penetrate the wood excessively and squeeze out to cause starved joints.

A spread of the correct amount is indicated by a semi-gelled ridge of glue extending continuously along each glue line following clamping. If the glue is running down the panel face or back, this is definite evidence of excessive spread and perhaps also of glue mix that is too dilute.

Animal glues have been established and used in wood gluing operations as versatile and reliable adhesives for many years. They are, however, unique in that, in spite of their long period of use, they have maintained their popularity over other types for a variety of bonding operations.

Hot glue conveyerized spreader being employed in a typical edge gluing operation. The unit is a 20-inch Taylor Hot Glue Applicator with a Taylor Clamp Carrier.

About the Author . . .

ROBERT C. GILL received his B.S. in chemistry from Duke University in 1949, and a Master of Forestry degree in 1950. A member of ASTM's D-14 Committee, he is in charge of wood adhesives development for Peter Cooper Corp.

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Room-Temperature Curing of

Polyurethane Adhesives

A new room-temperature curing system has been developed for curing polyurethane liquid resins. The system involves the use of an aromatic diamine dissolved in a glycidyl ether. The glycidyl ether serves both as an effective solvent for the solid diamine and as a possible reactive modifier for the polyurethane. Parts to be bonded can be assembled immediately after application of the adhesive or up to three hours later. Only contact pressure is required during the cure.

Polyurethane or polyisocyanate resins were introduced in Germany in 1937. However, in the United States they have approached commercial production only during the last two or three years. Their use has been primarily for the production of both rigid and flexible foams and for coatings. Although as adhesives polyurethanes are still in the development stage in this country, they are known to produce bonds to a wide variety of materials such as metals, rubber, glass, wood, textiles, paper, ceramics and numerous plastics.

The most important reactions of isocyanates are those which involve an active hydrogen as shown in equations 1 and 2. Extensive use has been made of the reaction between diisocyanates and glycols. The major product of this type of reaction is a polyurethane; the end groups depend upon which component is used in excess (See equation 3).

Polyfunctional Compounds

With the diisocyanate in excess, polymers which have both reactive isocyanates and/or reactive hydrogens are obtained. These polyfunctional compounds are used as adhesives.

Adiprene L is a urethane prepolymer resin used as an adhesive. It is reported (*1*) to be a reaction product of 2,4-tolylene diisocyanate and 1,4-butylene oxide polyglycol. The reaction is shown in equation 4.

The excess isocyanate can be further crosslinked by exposure to atmospheric moisture and converted into amines with the liberation of carbon dioxide (equation 2). The amine formed can react with another isocyanate group to form a symmetrical urea.

Advantage is taken of the gas-forming reaction between water and isocyanate in the production of polyurethane foams. In general, this reaction with water is important and must be taken into account in all isocyanate work, either to avoid gas bubbles or to produce gas for foaming. In adhesive work, large unbonded areas may result from unwanted gases produced in the reactions with water vapor.

One of the principal disadvantages of polyurethane adhesives has been the many difficulties encountered in the cure. Most polyurethane adhesives require either an elevated temperature curing schedule, heat to put the catalyst into solution or the application of considerable pressure during the cure. These curing techniques have proven to be time consuming and in many cases impractical.

With room-temperature curing polyurethane adhesives either a solvent or elevated temperature is required to put the solid catalysts into solution since no satisfactory liquid catalyst is available. Recently a method was developed in our laboratory whereby a polyurethane adhesive could be cured at room temperature by a solid catalyst, 4,4′-methylene-bis(2chloroaniline), [MOCA], dissolved in allyl glycidyl ether (AGE), a solvent that might serve as a reactive modifier for the urethane resin.

Heatless Process

No heat is required at any stage of this bonding process. The open time is not governed by the release of solvent, primarily because of the low vapor pressure exerted by the AGE, and possibly because of a reaction of the epoxide group with the Adiprene L. It is conceivable that the active hydrogen of the amide structure of the Adiprene L might open the epoxide ring on the allyl glycidyl ether. This would be possible only if steric hindrance were not offered by the adjacent phenyl group on the Adiprene L.

If a reaction were to occur, it would be a terminal reaction with no possibility of crosslinking. The AGE

► Equation I ◄

$$OCN\text{-}R'\text{-}NCO + RNH_2 \longrightarrow RHNC(=O)HN\text{-}R'\text{-}NCO$$

diisocyanate — primary amine — monosubstituted urea

► Equation II ◄

$$OCN\text{-}R'\text{-}NCO + 2H_2O \longrightarrow \left[R'\text{-}(NHCOOH)_2\right] \longrightarrow$$

diisocyanate — unstable carbamic acid group

$$R'(NH_2)_2 + 2CO_2(\uparrow)$$

primary diamine

► Equation III ◄

$$n\ OCN\text{-}R\text{-}NCO + R'(OH)_n \longrightarrow R'\text{-}(O\text{-}C(=O)\text{-}N\text{-}R\text{-}NCO)_n$$

polyol — polyurethane

could of course react with the active hydrogens on the MOCA thereby reducing the reactivity of the catalyst. However, it is not expected that either reaction would occur to any extent at room temperature in the short period of time that the adhesive is in the liquid state.

Adherends can be bonded at any time from immediately after application of the adhesive up to three hours after application at room temperature. Only contact pressure is required to produce a bond.

In preliminary tests a commercial, solvent type, room temperature curing polyurethane adhesive was evaluated for bonding to numerous plastics. This adhesive possessed several major disadvantages. The rapidly evaporating solvent created large unbonded areas and in some instances attacked the plastic. A temporary pressure of 50 psi was required to insure intimate contact during the bonding process. In addition, the open time was critical.

Three solventless polyurethane adhesives, Adiprene L, Vibrathane 6002 and Solithane 113 (2) were also evaluated for bond strengths obtainable to various plastics and to steel. The catalysts used were solid at room temperature and required heating before adding to the resins. Resulting adhesives were of high viscosity which made adhesive application and good wetting of the adherends difficult. The 5-10 minute pot life obtained with these adhesives systems is undesirable for many Ordnance applications. In addition, the use of heat for dissolving catalyst is often impractical, particularly for applications in the field.

Four-Hour Pot Life

Therefore, a recommended solution of MOCA catalylst in acetone was evaluated for curing Adiprene L and Vibrathane 6002. Pot lives in excess of four hours were obtained and the viscosities of the adhesives were decreased. However, the addition of acetone also gave the adhesives an increased tendency toward foaming. Another disadvantage of this method was that a 30 minute open time was required before assembly of specimens in order to permit evaporation of the acetone and thereby eliminate the risk of having large unbonded areas.

Adhesion to several plastics was studied in this investigation. These plastics included polyester, phenolic, melamine, polyetheylene, polymethylmethacrylate, polyvinyl chloride, polystyrene, cellulose acetate butyrate and cellulose nitrate. An investigation of adhesion to Cymac 325, Delrin, Penton, Lexan and Multrathane plastics with Adiprene L adhesive is described in a recent technical publication (*3*).

Double Function

It was thought that if a solvent with a low vapor pressure that might also serve as a reactive modifier for the urethane prepolymer could be used to dissolve the solid MOCA catalyst, the problems encountered when using acetone would be eliminated.

Therefore tests were conducted evaluating the following solvents: allyl glycidyl ether, phenyl glycidyl ether, dimethyl aniline, and Epon 828 epoxy resin (*4*). Shell Chemical Company's Curing Agent Z was also evaluated for room temperature curing of Adiprene L, Vibrathane 6002 and Solithane 113. Cyclohexanone was evaluated as a low vapor pressure solvent for MOCA catalyst in the cure of Adiprene L.

Castings & Films—Several 20 gram batches of Adiprene L and Vibrathane 6002 were weighed. Given amounts of each experimental catalyst solution were added to 20 gram batches of resin, mixed thoroughly, and poured into small polyethylene cups. A small amount of each batch was also cast as a thin film onto a polyethylene sheet. The castings and films were allowed to cure for 24 hours at room temperature before testing.

Tensile Specimens—Tensile specimens were prepared using hat shaped (button type) aluminum tensile pieces with one square inch bonding areas. For initial tests these metal pieces were cleaned with an acetone dampened cloth and then vapor degreased in perchloroethylene. Later, for purpose of comparison, aluminum tensile pieces were cleaned as mentioned above and then treated in a dilute chromic acid solution at 140°F for five minutes.

The chromic acid solution consisted of 30 parts by weight distilled

water, 10 parts by weight sulfuric acid (1.84 sp. gr.) and 1 part by weight sodium dichromate. The tensile pieces were then thoroughly washed under cold running tap water and air dried. After acid treating or vapor degreasing, they were placed in a desiccator until ready for use (not longer than 24 hours after cleaning).

Five tensile specimens were prepared for each variation of adhesive and test temperature. A thin coat of adhesive was brushed onto both bonding surfaces of each specimen. After allowing the desired open time the specimens were then jigged in place to keep them from sliding during cure. All specimens were cured for at least seven days at approximately 73°F.

Castings & Films—All castings and films were examined at 5-10 minute intervals for the first five hours after mixing, and any changes in viscosity, tack and color were recorded. These specimens were examined again 18 to 24 hours after mixing and evaluated according to visual appearances. They were then tested manually. Toughness of films was determined by stretching.

Tensile Adhesion—Tensile adhesion tests were conducted with variations of Adiprene L adhesive used to bond aluminum to itself. The Tinius Olson Plastiversal Testing Machine was used for all tensile tests. Specimens were pulled at the rate of 600 to 700 psi per minute in accordance with Federal Test Method Standard No. 175, Method 1011.1. Tests were conducted at temperatures of −65°F., 73°F. and 160°F. after conditioning in the test chambers at the test temperature for 1½ hours.

The test chamber consisted of an insulated box placed around the jaws of the testing machine with the specimens preconditioned and tested within the test chamber. The test temperature was attained by means of a thermostatically controlled "packages air" unit. Dry ice was used to attain low temperatures while electrically heated elements provided the heat for elevated temperatures.

MOCA catalyst was found to dissolve at room temperature in dimethyl aniline, cyclohexanone, phenyl glycidyl ether (PGE) and allyl glycidyl ether (AGE). However, the Epon 828 required heating to 185°F. or higher to dissolve the MOCA. Each of these curing systems with the exception of the one using cyclohexanone was evaluated for use with Adiprene L, Vibrathane 6002 and Solithane 113.

Several batches of adhesive were prepared varying the ratio of catalyst to Adiprene L and to Vibrathane 6002. The cyclohexanone/MOCA system was evaluated for use with Adiprene L only.

Upon examination of castings and films prepared with each material, the most satisfactory curing system was found to be MOCA dissolved in allyl glycidyl ether and added to Adiprene L in the following ratio:

12 parts by weight	Adiprene L
2 parts by weight	allyl glycidyl ether
1.1 parts by weight	MOCA

The same ratio of AGE/MOCA cured Vibrathane 6002 satisfactorily. These mixtures cured to hard rubber-like castings and very tough films. Vibrathane 6002 film, however, took approximately 48 hours to attain the same degree of toughness that Adiprene L attained in 24 hours. The Adiprene mixture had a four to five hour pot life, a relatively low viscosity and was easy to apply.

Tests Discontinued

Solithane 113 would not cure with the acetone solution, the allyl glycidyl ether solution nor with Curing Agent Z. All of these catalysts turned the Solithane into a milky colored material of high viscosity. Therefore, these tests were discontinued.

Cyclohexanone, when substituted for the AGE in the adhesive mixture given above, also produced hard rubber-like castings and tough films. However, the castings had numerous bubbles in them and the films were inferior in tensile strength.

The other curing systems evaluated were rejected for the following reasons:

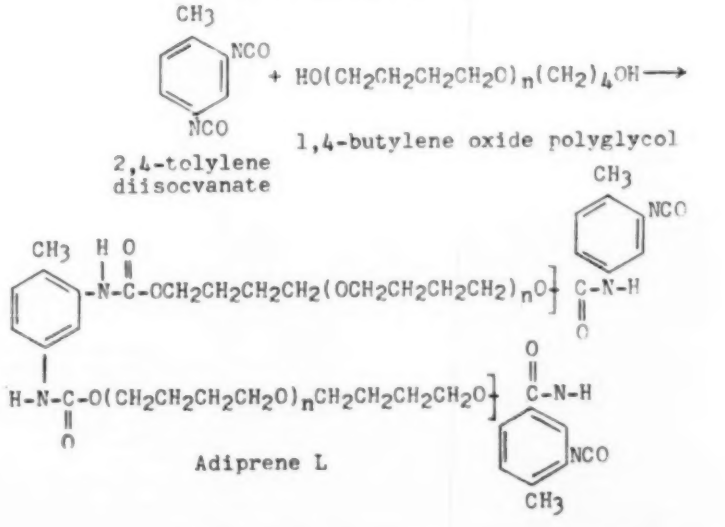
The phenyl glycidyl ether and the dimethyl aniline both settled out or separated from the Adiprene L and Vibrathane 6002 during cure.

The Epon 828 required elevated temperatures to put the MOCA into solution and resulted in a high viscosity adhesive. In addition, the Epon 828 mixture did not cure the Adiprene L after 24 hours. The casting and film were still soft and somewhat tacky. Although this mixture did cure after several days it was considered undesirable for most Ordnance applications.

Curing Agent Z when used to cure Adiprene L and Vibrathane 6002 gave extremely short pot lives. Films of these adhesives did not cure to tough materials at room temperature. However, when 0.5 parts by weight Curing Agent Z was added to 3.3 parts by weight MOCA dissolved in 6.0 parts by weight AGE and then used to cure 36 parts by weight Adiprene L, a clear brushable adhesive with a pot life of 45 minutes was obtained.

A cast film of the adhesive approximately 20 mils in thickness set up within 75 minutes. After 24 hours at room temperature, the adhesive

► Equation IV ◄



Comparison of Tensile Adhesive Bond Strengths of Five Polyurethane Adhesive Systems

*Adhesive**	*Curing Conditions*	*°F. Test Temperature*	*Surface Treatment*	*Open Time, Min.*	*Av. Tensile Strength, psi*	*High Load Value, psi*	*Low Load Value, psi*
1	7 days at 73°F.	73	Vapor degreased	0–2	938	1050	840
2			" "	0–2	1723	2000	1204
1	7 days at 73°F.	73	" "	30	589	1174	294
2			" "	30	948	1315	405
3			" "	30	250	292	190
1	7 days at 73°F.	73	5 min. in dilute chromic acid at 140°F.	30	1622	1749	1385
2			" "	30	1734	1925	1540
3			" "	0–2	1199	1240	1166
4			" "	0–2	1121	1206	1070
5			" "	0–2	1257	1301	1160
1	14 days at 73°F.	160	" "	30	1188	1235	1100
2	7 days at 73°F.	160	" "	0–2	1117	1168	1076
1	14 days at 73°F.	–65	" "	30	7470	7670	7240
2	7 days at 73°F.	–65	" "	0–2	4428	4725	4080

Note:* The parts by weight (pbw) formulations of the adhesive systems tested are as follows: (1) Adiprene L-10 pbw, MOCA-1.1 pbw, Acetone-3 pbw; (2) Adiprene L-12 pbw, Allyl glycidyl ether-2 pbw, MOCA-1.1 pbw; (3) Adiprene L-10 pbw, MOCA-0.9 pbw, Epon 828-1 pbw (the MOCA and Epon are heated to 185°F. for half an hour or until MOCA is dissolved, mixture is cooled and Adiprene L added); (4) Adiprene L-36 pbw, MOCA-3.3 pbw, Allyl glycidyl ether-6 pbw, Curing agent Z-0.5 pbw; (5) Adiprene L-12 pbw, Cyclohexanone-2 pbw, MOCA-1.1 pbw.

cured to a tough flexible film. However, it apparently requires a post cure at elevated temperature since it was not as tough as the adhesive mixture without Curing Agent Z.

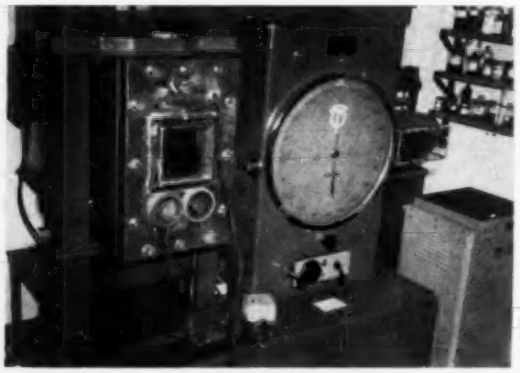
Two sets of aluminum tensile adhesive specimens were prepared, one using Adiprene L with the acetone/MOCA catalyst system and one set using the AGE/MOCA catalyst system. Higher average tensile adhesion values were obtained at 73°F. with the AGE/MOCA curing system than with the acetone/MOCA system, even when a 30 minute open time was used to allow the acetone to evaporate.

In view of these results it was decided to acid treat the aluminum in order to obtain more uniformity in the test results. Tests were conducted at –65, 73 and 106°F. comparing these adhesives for bonding to the acid treated aluminum. A set of test specimens utilizing the cyclohexanone/MOCA curing system with Adiprene L adhesive was prepared and tested at 73°F. only for purpose of comparison. The test results are shown in the table accompanying this article.

The AGE mixture gave slightly higher load values at room temperature than did the acetone mixture. However, at 160°F. the two adhesives exhibited essentially equal bond strengths. At –65°F. the acetone-adhesive mixture provided considerably stronger bonds than did the AGE-adhesive mixture. Although the former was cured longer than the AGE adhesive which might account for some of the increased bond strength at –65°F., some sacrifice in tensile strength at this low temperature must be expected when using the AGE formulation. Both adhesive systems gave higher bond strength values at room temperature than did the one utilizing cyclohexanone.

During the course of our experiments it was found that the polyurethanes possess high impact strength at cryogenic test temperatures. Specimens of cast Adiprene L and Solithane 113 were immersed in liquid nitrogen for one hour, then removed and immediately subjected to severe blows with a hammer. No fractures occurred. Polysulfide modified epoxy and silicone rubber subjected to the same test fractured at the first blow of the hammer.

It is expected that the AGE/-MOCA room temperature curing system when used with Adiprene L or with Vibrathane 6002 polyurethane adhesives will produce satisfactory bonds to a wide variety of materials, especially where very high bond strengths are not required. Since no open time is required, parts can be assembled any time up to three hours after application of the adhesive. Only contact pressure is required to obtain a satisfactory adhesive bond. Jigging of the components may be desired to prevent slippage.



Specimens are preconditioned and tested within the insulated box placed around the jaws of the Tinius Olsen Plastiversal Testing Machine.

Curing Agent Z can be used effectively to increase the rate of cure of the polyurethane adhesives when used in conjunction with the AGE/-MOCA curing system. Variation in the ratios of the components can undoubtedly be used to obtain adhesives with different curing rates and pot lives. Undoubtedly greater crosslinking and better high temperature properties can be realized if this adhesive is post-cured at an elevated temperature such as 200°F. or higher.

NOTES:

(1) A. J. Quint, "A Castable Polyurethane," Sandia Corporation Report (Oct. 1958). Available from Office of Technical Services, Washington 25, D. C.

(2) Adiprene L and MOCA, products of E. I. du Pont de Nemours & Company, Inc. Solithane 113, product of Thiokol Chemical Corporation.
Vibrathane 6002, product of U. S. Rubber, Naugatuck Chemical Division.

(3) M. J. Bodnar and W. J. Powers, "Adhesive Bonding of the Newer Plastics," Plastics Technology (August 1958).

(4) Epon 828/MOCA/Adiprene L formulation was recommended by Franklin Institute.

The views expressed by the authors are their own. They do not express an endorsement of any company or its product by Picatinny Arsenal, the Ordnance Corps or the Department of the Army. Acknowledgement is made of the work of Marjorie St. Cyr who conducted an extensive evaluation of several room temperature curing polyurethane adhesives which utilized the MOCA/acetone curing system for bonding various plastics.

About the Authors . . .

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Adhesive Bonding

In Roof Panel Fabrication

The selection of an adhesive bonding material that would give stability and strength to prefabricated roof panels was a problem confronting the Hess Manufacturing Co., Quincy, Penna. When they designed the new giant size Armaclad roof panels for patios, it was necessary that the panels have the inherent strength to meet building code snow load requirements. In order to obtain this strength, the Hess Company decided to use a balanced sandwich construction which provides insulation in addition to strength. It also enables the panels to withstand heavy loads and reduces erection cost because they are self-supporting and need no understructure.

The fabrication of such a sandwich panel consisted of bonding a rigid underskin of fiberboard to each side of a strutted core of kiln-dried fir and applying a patterned aluminum sheet to each side of the panel. This entire assembly is then bonded together, using heat and pressure, into a single unit that uses to full advantage the strength factors of each component part.

For the bonding material, Hess wanted something that would combine some of the qualities of both the thermosetting and thermoplastic adhesives. Their research showed that an adhesive made by the Armstrong Cork Co., D-288 Adhesive, was perfectly suited for the job as it met the necessary specifications.

The adhesive chosen would have to withstand included static load, water and cycling exposures involving marked changes in temperature and moisture conditions. The true thermosetting adhesives would be too brittle and the true thermoplastic materials are too soft and allow creep. However, D-288, one of a group of neoprene adhesives, fell midway between these two types and provided an ideal bond for these giant prefabricated panels which are two feet wide and can be made practically any length within reason, and as thick as the load factor requires to sustain its own weight without understructure such as joists and tubing.

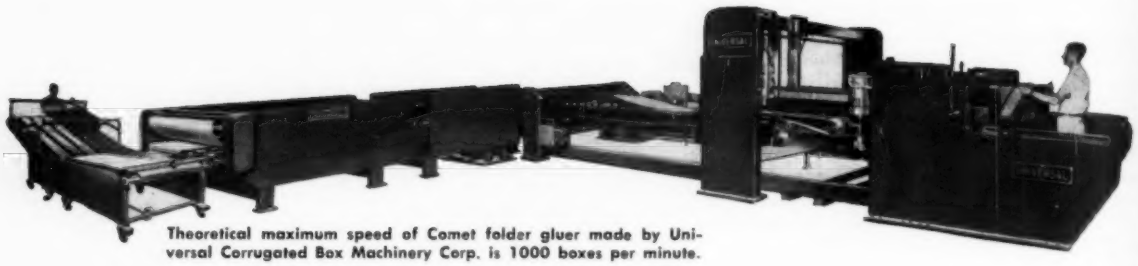
The adhesive selected provided the Hess Company with a tough resilient bond which will stand up under the high ever-changing shear stresses set up by the different coefficients of thermal expansion of the bonded materials, as well as stresses caused by wind loads on exterior panels, and other variable forces. It also is useful at service temperatures up to 180°F. and will withstand brief exposures to the higher temperatures often encountered in panel processing operations.

The Armstrong adhesive proved to have a dynamic tensile-shear strength in the range of 1500 psi in aluminum-to-aluminum bonds, and it bonded firmly and permanently upon contact. These factors made it ideally suited to the fast assembly line fabrication of the Armaclad roof panels, which uses pressure rolls to combine core and skins. The prolonged clamping and curing as well as the extra handling involved with the use of conventional thermosetting adhesives had been eliminated.

Adhesive Application

In its operation, the Hess Company first bonds hardboard to the aluminum skin by roller coating the adhesive to both surfaces. The aluminum and hardboard are then combined, after drying, through pressure rolls. This two-ply skin is then coated with D-288 by spray application as are both sides of the wood frame. The final assembly is made by mating the two-ply skins with the frame and passing the entire assembly through pressure rolls. Aluminum skins are usually bonded on both sides but the aluminum can be eliminated from the underside in enclosed areas so that the patio ceiling can be painted or covered with one of the many attractive acoustical ceiling tiles now on the market.

Through the use of an adhesive bond, the Hess Company solved its strength problem and produced a roof panel that is attractive, easy to install and comparable or lower in cost than painted sheet metal awnings.



Theoretical maximum speed of Comet folder gluer made by Universal Corrugated Box Machinery Corp. is 1000 boxes per minute.

Adhesives and Equipment for

Glue Lap Corrugated Containers

By D. G. WILLIAMSON
President
Williamson Adhesives, Inc.
Skokie, Illinois

In the corrugated container industry, the number of plants using the manufacturer's glued joint is steadily increasing, as is the number of glue lap containers being made. This trend, and trend it seems to be, has been encouraged by the development of excellent automatic and semi-automatic machinery and suitable adhesives for use on these machines.

Since the early stages of this switchover in the container industry, several of the nation's top adhesives manufacturers have been developing and supplying special glue lap adhesives. These products have been used in many of the leading corrugated plants all over the nation, and on a wide range of machines. Several types of adhesives are supplied depending upon the equipment being used and the properties required in the finished container.

In addition to many operational advantages of what is known as the "manufacturer's glued joint," there are also many advantages from the point of view of the finished container. It is the most versatile joint in terms of box design, and is the only joint which can leave the entire surface available for printing. It should also be noticed that high production speed is not possible with any method other than adhesives.

A number of machines have been used to produce containers involving the glued lap joint. They range from converted tapers to gluing machines specifically designed for this operation. Some of these are illustrated here.

Machine production, however, requires extremely versatile adhesives for satisfactory results. Fortunately, those based on polymer emulsions meet these exacting requirements. Nearly all of the adhesives recommended for this operation are based on polyvinyl acetate.

This is because the base material or film-former is not subject to the wide variation in properties that is found in natural materials. In addition, the polymer can be produced on a continuous basis to give even greater uniformity to finished adhesive products.

Desirable Characteristics

Tests have shown that the basic emulsion has many desirable characteristics which will carry over into properly compounded adhesives. Chief among these are the following: high solids, low viscosity, water resistance, inertness, film transparency, non-toxicity, and negligible odor.

The emulsion polymer is a fairly complex system composed of two phases. The continuous, or water phase, acts as the vehicle to carry the polymer into contact with the substrate. The discontinuous, or adhesive phase, is in the form of finely divided particles. In order to produce suitable adhesives from this material, consideration must be given to several desirable end properties.

Plasticizer— The finished adhesive should be properly plasticized. This gives impact strength and flexibility to the bond. Improperly plasticized products produce bonds which do not have adequate heat resistance, may become brittle during storage, or give an undesirable odor to packaged merchandise.

Viscosity—For easy application and handling, the viscosity should be fairly low. Care should be taken, however, that the solids are not markedly reduced and that emulsion settling is not accentuated.

Machineability—Without thickening or showing a strong tendency to skin-over, the product should operate for extended periods in the glue system.

Defoaming—The adhesive should operate for extended periods in the glue system without foaming.

Setting Speed—While the setting speed should be fast enough to permit maximum machine speeds, the adhesive should nevertheless operate suitably at lower speeds.

Adhesive Bond—The ideal material should dry to a colorless film so

that any squeeze-out is not noticeable. Its water resistance, heat resistance and strength should be consistent with the product's end use.

Emulsion-based adhesives generate their bond structure in a somewhat different manner than systems which are dissolved in the solvent or carrier. For example, when a typical dextrine adhesive is placed between two sheets of paper, it gradually increases in viscosity due to the loss of water to the paper stock. However, as the viscosity increases, it impedes the further loss of water to the sheet. After 25-40 seconds, sufficient water has been lost (and viscosity is so high) a fiber-tearing bond is produced.

When an emulsion adhesive is placed between two sheets of paper it also loses water to the sheets, but the viscosity increase is not as pronounced. Hence, the continued loss of water is not markedly impeded. After the loss of a given amount of water, the emulsion becomes unstable and is said to break. This is known as inversion, and the polymer phase becomes continuous.

Increase in Viscosity

At this point, there is a very sharp increase in viscosity and a fiber-tearing bond is developed. This generally occurs in three to eight seconds (using a 1 mil glue film). However, this time period can be adjusted to meet specific requirements.

There are many factors which effect the adhesive bond and its speed of development. Among the more important of these is the paper itself. The type of stock, the weight, the moisture content and the finish can all exert influence upon the operation.

From the adhesive standpoint, the film thickness and the application temperature are important. The thicker the film application, the longer the time required for bond development. This can be important in "squaring" operations, since the speed can be adjusted, through the adhesive application, to any given production rate.

The application temperatures of both adhesive and board are not important factors in the 70° to 90°F. range. At low temperatures, however, this is not the case. The setting action of emulsion adhesives depends upon the coalescence of the individual polymer particles. At lower temperatures, the particles are harder —higher polymer viscosity—and coalescence, or fusion, is hindered.

For example, at temperatures near the freezing point of water, many emulsions are not free-filming. In addition, bonds accomplished at very low temperatures may show failure later. The addition of excessive amounts of plasticizers to overcome this difficulty can result in soft, tacky bonds with poor heat resistance.

The quantity of adhesive required for proper bonding of the boxboard joint is a distinct variable. It will depend upon the adhesive, its specific gravity, its solids content and the film application thickness. These factors will, of course, be modified by the porosity of the board, machine speed, etc. In any event, the only sure way to determine mileage or cost figures is by actual plant trial under carefully controlled conditions.

However, certain generalizations on mileage are possible. For example, using one gallon of adhesive as standard, and assuming that two to three mils of wet film application is necessary for adequate bonding, the coverage figures are as follows: a two mil wet film will cover 802 square feet, a three mill wet film will cover 535 square feet.

For a two mil application this means that 115,500 lineal inches of one inch wide glue line can be obtained from one gallon of adhesive. In such a case the data can be expressed in the following cost formula.:

$$C = \frac{(L \times G \times P)}{115.5}$$

In the above formula, C is the adhesive cost per 1000 containers, L is the linear inches of one inch wide glue line per container, G is the weight in pounds of one gallon of adhesive, and P is the cost per pound of adhesive.

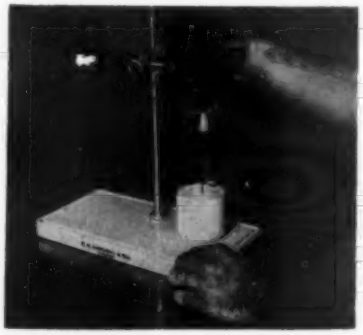
In theory, the manufacturer's glued joint is superior to either stitched or taped joints because the bond is distributed over the entire surface area of the joint. The stresses are therefore distributed uniformly, and potentially troublesome isolated points of high stress are avoided.

In order to produce authoritative comparative data, a series of tests sponsored by Williamson Adhesives and others were conducted by an independent laboratory.

Relative Efficiency

The basic purpose of these tests was to develop information concerning the relative efficiency of taped, stitched and manufacturer's glued lap joints of corrugated fiberboard boxes exposed to normal atmospheric conditioning, very humid atmospheric conditioning and very hot atmospheric conditioning with subsequent cooling. The boxes used varied in size, shape, certificate grade, facing, flute of corrugations, orientation of contents, gross weight and special reinforcement.

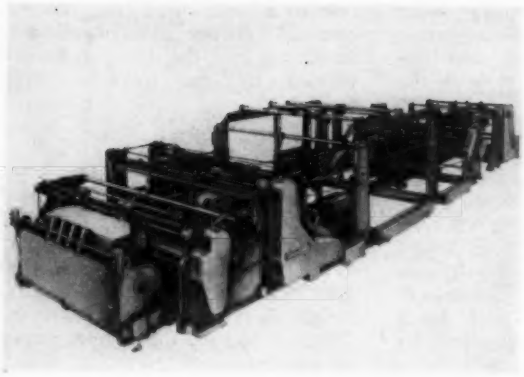
The tests employed to obtain the data consisted of revolving drum, drop, compression (in the top-to-bottom, end-to-end and side-to-side directions) and tensile tests upon



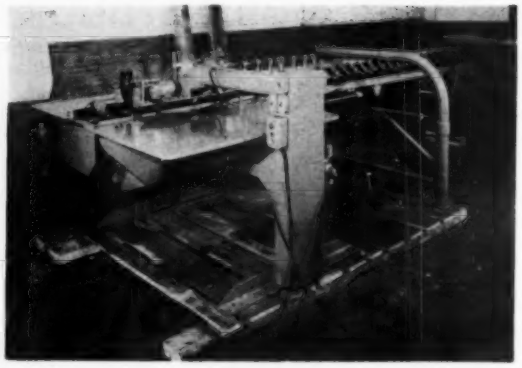
Viscosity check of a typical glue lap adhesive is made in the Williamson Quality Control Laboratory.

Application of uniform pressure with a rubber covered weighted roller is part of setting speed test.

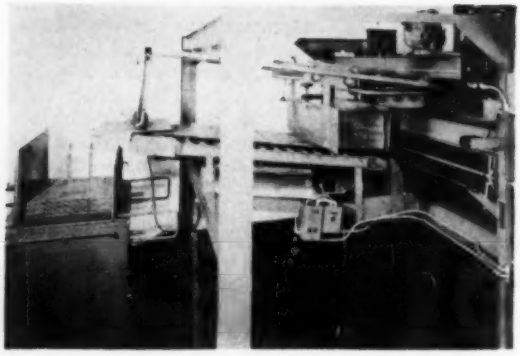
Setting speed test of glue lap adhesive also requires check to assure uniform glue film thickness.



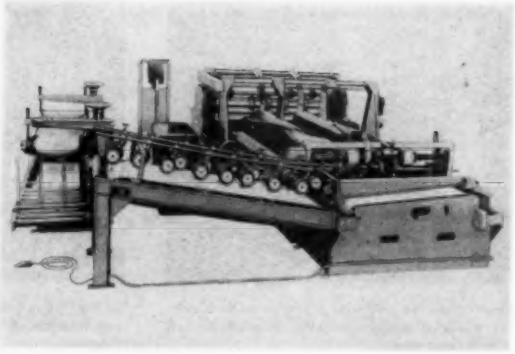
International Paper Box Company's LB Corrugated Gluer. Intaglio type glue wheel carries the glue in a multitude of small surface depressions.



Semi-automatic glue lap unit of S.M. Langston Co. lends itself to short orders and boxes too large for fully automatic folder gluers.



General Corrugated Machinery Company's Semi-Automatic Lap-Gluer delivers boxes into squaring device which as also compression section to set adhesive.



Bostitch BJ Folder-Gluer feeds, folds, glues, squares and counts boxes. It operates at rated speeds up to 10,000 per hour.

the joints. In addition, routine identification tests, including bursting and flat crush, were carried out to determine the conventional properties of corrugated fibreboard.

A judicious evaluation of the results of these tests is contingent upon a preliminary awareness of several factors which researchers had to take into consideration.

For example, the relative effectiveness of different types of manufacturer's joints is not constant and varies with many different factors such as container size, shape, certificate grade, type of contents and arrangements thereof. The box samples studied were selected after due consideration had been given to these variables, and represent a good cross-section within practical limits. Nevertheless, the relationships developed apply to the containers actually analyzed and are not necessarily characteristic of boxes with other sizes, shapes, etc.

Widely Varying Quality

It should also be noted that tapes of widely varying quality are used for manufacturer's joints. During testing, only one grade was evaluated and obviously it could not be representative of all taped joints. On the other hand, it was one of the more commonly used types.

Most of the boxes employed for durability investigations were specially reinforced at all scores other than the manufacturer's joint. This tended to confine box failure to the latter element. However, despite these measures, many of these containers failed along a score other than that at the joint. The results nevertheless proved conclusively that the joint was more durable than other box parts.

With the above points in mind, test results can be expressed as follows:

(1) The over-all rigidity, involving compressive resistance in three directions after standard atmospheric conditioning was substantially similar for all three manufacturer's joints currently used. The 1¼" glued lap had the highest cumulative resistance and the stitched joint had the lowest. The difference between the two extremes was three per cent.

(2) The durability of the 1¼" glued lap boxes was at least as good as that of stitched and taped boxes and in many instances even better. This relationship prevailed after standard atmospheric conditioning, high humidity conditioning, and high

temperature conditioning. In the aggregate, stitched joints appeared to provide greater durability than taped joints, but the relationship was not clear-cut.

(3) Regardless of the conditioning which preceded the tests, the 1¼" glued lap had the greatest joint tensile strength by a wide margin. The taped joint was better than the stitched joint in this property.

(4) The degree of compression of the glued lap had little effect upon the cumulative compressive resistance. The groups with no compression of the lap had the highest overall rigidity and those with extreme compression of the lap had the lowest overall rigidity. However, there was only a four per cent variation between the two. The relative durability could not be evaluated since box scores failed in the revolving drum and drop tests, and the manufacturer's joints were left intact.

(5) Orientation or positioning of the glued lap did not have a profound effect upon compressive resistance. The indications are, however, that fastening the lap to an end panel, either inside or outside, is best from a rigidity standpoint. Fastening the lap to the outside of the side panel gave the poorest results. Once again, the relative durability could not be determined since all joints were less vulnerable than the box scores.

(6) Glued joints with a one-inch lap provided slightly lower results than those with 1¼" laps, although the differential was small. The narrower lap had a four per cent lower overall rigidity, provided slightly less durability (although still somewhat greater than that of stitched or taped joints) and had almost the same joint tensile resistance as the 1¼" lap.

About the Author . . .

D. G. WILLIAMSON graduated from Dartmouth College in 1942 and joined Williamson Adhesives the same year. He has been president of the company since 1948. Mr. Williamson is a member of Adhesive Manufacturers Association; Rubber and Plastic Adhesive and Sealants Council; and Chicago Section of TAPPI.

Adhesive is applied to the rubber plate's back prior to alignment in the metal clamping frame. The support plate is then inserted into the frame.

Automatic Check Endorser Requires an Ink-Resistant

Rubber-to-Steel Bond

At Recordak Corporation, engineers found that the endorsing mechanism of recently designed microfilmer-endorser equipment presented a problem in rubber-to-steel bonding. There seemed to be no practical method of securing the flexible printing plate to its steel support. Vulcanizing techniques were too complicated and available adhesives could not withstand the solvent action of the printing ink.

Metal vs Rubber Plates

An attempt was made to bypass the problem by using all-metal printing plates on the unit's small rotary press. It was found, however, that they did not wear as well as rubber plates and that registry was often difficult, requiring careful alignment.

The bonding problem was finally solved through use of the recently introduced Eastman 910 Adhesive. Research technicians reported that rubber-steel test strips immersed in printing inks for several days showed no loss in adhesion. Subsequent field tests established that the bond produced was good for the life of the rubber plate.

Assembly of the endorsing plate has been greatly simplified and is carried out in Recordak service centers in all parts of the country. Adhesive 910 is spread in a thin layer on the reverse side of the rubber plate which is then inserted—adhesive side up—in a metal clamping frame. The steel back-up support, to which a small amount of adhesive has also been applied, is then placed on top of the rubber plate.

To insure even distribution of the adhesive between the rubber and the steel, a slight pressure is applied by means of a screw clamp. After several minutes, the plate assembly is removed from the clamping frame and is ready for immediate delivery and installation in microfilmer-endorser equipment.

Two-in-One

Most banking institutions maintain a microfilm record of all paid checks. The new Recordak unit combines microfilming and routine endorsing into a single operation in order to save banking institutions the time and the expense of separate equipment setups.

Since cancelled checks are returned to the customer, most banks retain a permanent microfilm record of all paid checks. Recordak Corporation is a subsidiary of the Eastman Kodak Company.

STAFF REPORT

The Lady Builds a Bonding Business

A woman of considerable charm and relaxing femininity, Phyllis Holman Larsen is an immediate challenge to one's stereotyped preconception of the lady executive. Nevertheless, the record clearly shows that for more than five years, as president of Larsen Products Corporation, she has successfully guided the destines of a fledgling company to the point where it has a solidly established nationwide distribution for its liquid bonding agents, and boasts outlets in Italy, England, Venezuela, Panama, Mexico, Chile and other foreign countries.

In 1952, an inventor named Herbert H. Larsen established his own company to manufacture and market radically new construction materials which made it possible to permanently bond wet plaster to cement, and fresh cement to old cement. Plaster-Weld and Weld-Crete met with immediate industry-wide interest. However, during the initial period when the product had still to prove itself, a considerable expenditure of time, energy and enthusiasm was required. The headaches, heartaches and hectic moments proved to be too much of a strain, and after 13 months of actual company operation, Herbert Larsen died of a heart attack.

"Suddenly, my life as a housewife was turned upside down," recalls Mrs. Larsen, "and I found myself on the brink of a new world—a man's world." There could be no question of letting the business be absorbed by outsiders. Too much work, hoping and dreaming had gone into it for it all to come to nothing now. Mrs. Larsen decided to go on with the business and see what she, as a woman, could do in the unfamiliar world of the construction industry.

The lights in the plant office in Bethesda, Maryland, burned day and night, while she pored over bills, orders, correspondence, laboratory reports, literature and trade publications in an effort to understand her business. An alumna of Wheaton College, Norton, Mass., and the Chamberlain School of Retailing, Mrs. Larsen's educational background was based solidly on the liberal arts. For the most part her experience in the business world had consisted of fashion counseling, interior decorating and craft teaching.

However, neither college courses nor textbooks could provide the type of training she sought. Trying to analyze her husband's success, she realized that it had not been brought about by sitting behind a desk in Bethesda. She felt that direct contact with architects, engineers, contractors and distributors would be a two-way educational process. After all, Plaster-Weld and Weld-Crete were based on a new concept in the construction industry, and in a sense, potential users had as much to learn as she did.

"During the next five years," Mrs. Larsen relates, "I traveled well over 100,000 miles, setting up our international sales and marketing organization." This work included trouble-shooting, attending sales conventions, establishing distributors, inspecting actual jobs where company products were being used, and consulting with some of the nation's leading architects and builders.

At the factory, the problems were as manifold as those in the sales territories. "There were," Mrs. Larsen recalls with a slight shudder, "legal aspects of the business that had to be understood." Accounting procedures, office management, factory efficiency, none of this had been covered in any of the courses at Wheaton. "However," Mrs. Larsen states, "training in the liberal arts *had* taught me how to think clearly and that seemed to be basic to everything else."

In the ensuing years, many executive decisions had to be made. For example, Mrs. Larsen wisely deferred accepting a patent on formulation alone and now her products are protected by the broader concepts of a process patent issued in August 1956.

In many of the larger cities, it was necessary to obtain approval of the local building authorities before Plaster-Weld and Weld-Crete could be used. Laboratory tests were in process continually to meet varying demands for proof of performance. Architects and contractors meeting

First hand knowledge of how the company's products are received in the field is an important part of business building. Mrs. Larsen is shown here inspecting a new Tile-Weld installation.

Mrs. Larsen for the first time were amazed not only by her ability to speak their language, but by her knowledge of building trends and local construction practices.

Anxious to retain the custom-tailored features of Plaster-Weld for plaster work and Weld-Crete for concrete work, Mrs. Larsen was disturbed when it came to her attention that both these products were being used in the tile field. She immediately set her laboratory to work to develop a product specifically designed to meet these somewhat different needs. In June 1957, Tile-Weld was introduced to provide the industry with an admix that would improve but not discolor cement grout.

In the spring of 1955, growing inquiries from various foreign sources prompted Mrs. Larsen to set off in search of new markets abroad. Her first stop was in Rome.

Were Italian businessmen at all disturbed by having to deal with a woman? Not at all, Mrs. Larsen recalls. As a matter of fact, the English distributors and contractors with whom she spoke seemed to be considerably more curious about the situation and wanted to know if there were many American women active in the construction field. "No, not many," she reassured them.

As time passed and her sales staff was built up, Mrs. Larsen slackened her travel pace. However, industry conventions and conferences are still a must for keeping in touch with the market.

What part of the job does she like best? "Sometimes I move in the exciting world of sales promotion, and this is my special business hobby. It brings me into contact with the field of advertising—printers, writers, packaging experts and so on."

What part of the job does she like least? "Well, financial accounting legal details and office routine," she confesses.

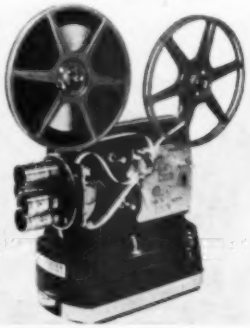
At the present time, the output of Larsen Products Corp. is sold in every state by some 3500 building supply dealers. Outstanding applications of these products are very much in evidence all over the world.

In New York City, for example, Plaster-Weld was used for complete interior wall and ceiling plastering of the recently renovated Hotel Manhattan. In Rome, highway repairs have been made with Weld-Crete. In this country, Weld-Crete was used in renewing the old stucco surface of the Pan American Union Annex, Washington, D.C.

Summing up her experience over the last few years, Mrs. Larsen concludes, "It isn't anything any American woman couldn't do if she had to. After all, I had confidence in the product and felt that all my husband's work and dreaming simply must bear fruit."

Functional Range of Versatile Epoxy Adhesive

from this . . .



Production engineers at Obex Corp. needed a heat-resistant adhesive to hold a reflecting mirror behind the projection light of their Wittnauer camera-projector. They finally hit upon Preco Chemical Corp.'s Rock-Weld, an epoxy adhesive that cures hard under heat, forming a permanent bond.

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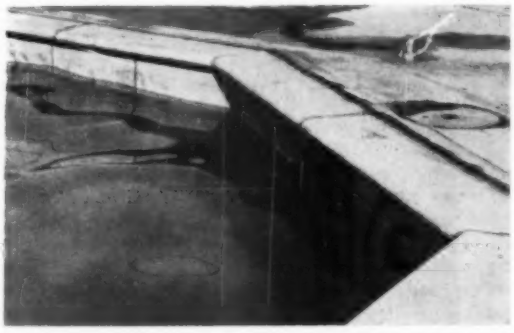


Time for setting the coping around this pool for a New York apartment house project was cut from a full day to less than two hours by using a mortar made of the same epoxy adhesive mixed with sand. Installation time and labor savings more than paid for the increased material cost.

STAFF REPORT

Non-Woven Fabrics:
A Modern Adhesive Miracle

Non-woven fabrics manufacturing constitutes a multi-million dollar market for the adhesives industry. This history making innovation in the textile field—which is fast revolutionizing design in the garment trades—rises as a rich prospect for adhesive compounders with the opportunity for high volume as a reward for overcoming the many pitfalls.

Estimates are that over $10,000,000 worth of adhesives were purchased by the infant industry during 1958. Those close to the market say this consumption rate will continue to climb with the many new developments that are being announced almost daily.

Exactly what are non-woven fabrics? Basically these modern miracles are structures of fibers held together by a bonding material which is applied to the fiber mat by emulsion, coating, printing or spraying techniques. Many people in the textile and chemical industries prefer to call them "bonded fabrics" or "chemically woven fabrics."

The non-woven or bonded-fiber fabrics attracting such wide attention today were made possible by the availability of specially compounded polymeric binders or adhesives as well as new developments in processing equipment. The field is in its infancy with even the most visionary failing in predictions for the future.

Widely used in the garment, shoe and luggage trades for inner facings, inner linings and shaping materials, non-wovens are also finding application in the upholstery materials field as sturdy all-elastic backers for the vinyl plastics. Producers of these modern textiles include such well-known industry leaders as the West Point Mfg. Co., Wellington Sears Co., Pellon Corp., and Chicopee Mills, Inc.

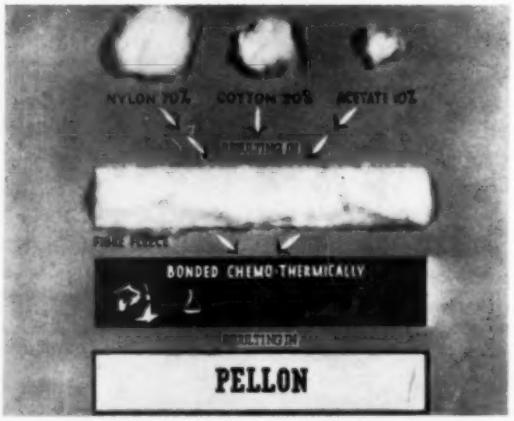
Because of their great elasticity, bonded fiber fabrics do not wrinkle easily, and after the most severe crushing they spring back into normal shape. Non-wovens are made of basic fibers such as nylon, cotton, acetate, Dacron, wool, etc. Depending upon the delicate blending of the bonding agents and fibers, they can be made smooth, soft, firm, supple, thick or thin, for just about any end use.

The Best Is Yet

It has been pointed out that the most interesting part to be played by non-wovens is yet to come as the delicate fiber bonding operation is further developed in new fabrics of more varied and wider uses. The industry is moving at a terrific pace, and a process or formula new today is likely to be discarded by tomorrow. One adhesive supplier reports that not a single item in his line is more than three years old.

The ultimate goal of non-woven fabrics is to achieve the hand, the drape and the softness comparable with woven fabrics. However, there are many production difficulties to overcome. For example, many of the binders or adhesives used in the past have had a tendency to stiffen the materials or cause a fabric harshness.

Bonding agents used in the production of non-woven fabrics may be grouped in three general classifications: thermoplastic fibers, thermoplastic or thermosetting resin powders, and emulsions. In addition, solution binders of the water or solvent soluble type are possible bonding agents. However, they are very rarely used because of problems of water sensitivity, solvent recovery and fire hazard.



Flow chart illustrates the various steps involved in the production of Pellon, a lightweight directional fabric put out by Pellon Corp., New York, N.Y.

Thermoplastic fibers used as a binder are randomly distributed in the web. Because they have a lower melting point than the other fibers in the web, the thermoplastic fibers fuse and bind the whole together as the web passes through heated rollers.

Among the first binders of this type were the plasticized acetate and vinyl resin fibers. Those were followed by the development of acrylics, polyester and polyamide fibers of special low melting point. While the latter make it possible to bond the web by activating them with solvents, it is usually found that the application of heat and pressure provides greater control of the operation.

The amounts of applied resins may vary from 5 per cent resin—based on the weight of the fiber—to as high as 50 per cent. It should be remembered that the resin is not merely a production auxiliary but an integral part of the entire non-woven structure.

Because the thermoplastic fiber technique is more expensive than the other available methods, it is usually only used in the production of tapes, ribbons and other decorative materials in which appearance and sales appeal is more important than finished physical properties.

Similar to the action of thermoplastic fibers is that of thermoplastic or thermosetting resin powders. The latter are dusted onto the formed web which then passes through heated rolls to bring about a fusion of the whole. Difficulties in achieving even distribution of the resin have kept this technique from being too widely used, though they seem to be coming into favor for low density non-wovens. Generally the technique is used in the manufacture of extremely compact fabrics where uniformity of finish is of lesser importance.

Most Popular Binders

Water-based emulsions are the most popular binders for bonded fabrics. This is due to the wide variety of materials available, the extensive range of possible properties and ease of handling. Saturation, coating or spraying techniques are the conventional methods by which emulsions are applied to the formed web.

A relatively cheap but non-permanent type of binder is starch. It also has the virtue of being easy to apply, but the end product is a rather brittle non-woven fabric, and thus it is rarely used.

Modern processing machines convert a variety of fibers efficiently and economically into versatile non-woven fabric, wadding and felt.

In the production of disposable end products, polyvinyl alcohol is sometimes used as a preliminary binder. A must where freedom from odor and taste are important considerations, polyvinyl acetate is a popular liquid dispersion binder because it produces good strength and flexibility in the fabric.

Pigments Incorporated

Acrylics are being used as binders more and more often because they provide a fabric with a soft hand, and possess good adhesive properties and color stability. Pigments are also being incorporated into acrylic emulsions, thus combining the functions of binding and coloration. Fabrics made in this way are resistant to washing or drycleaning.

Polyvinyl chloride latices provide fabrics with a leathery finish. Though they are tough and have good wet and dry strength, they are not very elastic.

Compositions of butadiene-acrylonitrile and butadiene-styrene offer a combination of good adhesive and elastic properties. A short cure is necessary for those of high butadiene content as they are usually more rubbery.

No matter which of the binding systems is selected, neither the amount nor type of binder can be arbitrarily set, but must be worked out on the basis of the final product's end use and the type of processing equipment available.

The non-woven field is generally an attractive one for the supplier of adhesives or binding agents, but not without its pitfalls as anyone in the business will tell you. No two manufacturers of non-wovens conduct their businesses in the same way, and there is no standard pattern insofar as processes, chemical formulas or other elements of production are concerned.

Most manufacturers are inclined to be reticent about the details of their production processes. Under these circumstances it is easy to understand the difficulties with which suppliers are faced.

This is especially true of adhesive suppliers inasmuch as the binding agent plays such a dominant role in the manufacture of non-wovens. Because he moves from one manufacturer to another, the adhesive supplier is often called upon to be a super-diplomat.

Procedures for testing adhesive supplies present another difficulty to overcome. Tests will vary notably from manufacturer to manufacturer and attempts at standardization have proved futile.

Basic Principles

A knowledge of the basic principles of the non-woven manufacturing process can serve as an important guide to the adhesives man about to contact the industry or already involved in its operations.

Non-woven fabrics can be made from almost any type of fiber. The different binder systems or adhesives used in their manufacture greatly influence the end product's use and appearance.

For example, with the proper selection of binders, stretched non-woven fabrics will show a high degree of elastic recovery. This property is partially responsible for their use as backing for vinyl film sheeting. For this application, non-wovens

are not only cheaper than knit or woven fabrics, but hold the vinyl embossing better.

The development of polymeric binders in latex form has contributed much to the manufacturing achievements of non-wovens. Through compounding, the latex system makes possible a wide modification of the end product. It does much toward supplying a binder tailored to meet specific use requirements.

At Pellon Mills, Lowell, Mass., non-woven Pellon is wrapped in special shoe folds for prompt delivery to shoe factories where it will be used as interlining.

Latex Bonded Fabrics

There are seven major considerations in making latex bonded, non-woven fabrics, according to Goodyear Tire and Rubber Co., one of the major adhesives suppliers for the industry.

(1) Formation of the fibers into the desired type of web.
(2) Saturation of the web with the binder.
(3) Drying and heat processing the saturated web.
(4) Finishing.
(5) Selection of the fiber blend.
(6) Selection and compounding of the binder system.
(7) Testing.

Equipment for non-woven fabric production varies, of course, with the type of fabric. However, many differences are due to the lack of commercially available units and the fact that the majority of manufacturers have had to design and build their own equipment. These units represent investments of hundreds of thousands of dollars and design detail are closely held secrets.

Two basic fiber structures are possible for non-wovens. oriented web structure and random web structure. In the former, the fibers are essentially parallelized resulting in a fabric with good strength properties in the machine direction, but little or no strength in the transverse direction. The random web, on the other hand, is characterized by a lack of fiber parallelism and results in a fabric with essentially equal strength in all directions.

Oriented Webs

An oriented web is produced on conventional textile equipment. Fibers are opened, picked, cleaned and then fed to a series of cards or garnetts which superimpose a series of webs on a conveyor apron.

To modify the oriented web, fibers can be deposited at right angles to the conveyor direction. The result is a material with strength properties between those of the oriented and random type non-wovens.

In random fiber web production, fiber parallelization is limited to the initial processing steps. Some conventional web forming equipment can be modified to provide fiber randomness, but the best results are obtained with units specifically designed for the job. The latter suspend fibers in a swift air stream and deposit them in a uniform manner. Careful grounding and humidity control eliminates static effect.

Choice of equipment for binder application will, of course, depend on the type of fabric being run. Two basic bonding techniques are currently used with dispersion bondants: discontinuous and continuous bonding.

In the former, the bonding material is applied to the web in a definite pattern, usually to the extent of less than 50 per cent of the web. An operation similar in principle to printing gives the web its pattern. Although they have good drape and fabric-like hand, discontinuously bonded fabrics have poor strength properties, particularly in the transverse direction in the case of oriented webs.

Of course, the pattern employed will determine to a large extent the strength and elongation properties of the final product. At optimum distribution, patterns such as bars and diamonds will impart higher transverse strength and elongation, even though the actual area bonded may be less than that obtainable with other patterns.

In the case of continuously

A photo-demonstration of the stain resistance of Wellington Sears' vinyl-based Lantuck. Here it has been used in "Fabrique," a Birge Co. wall covering.

bonded fabrics, the bonding materials is generally applied in an impregnating bath and any excess removed by squeeze rolls before the web is belt-fed to the dryer. Saturation is a critical part of the entire operation, and because there is no commercially available equipment, most producers of non-wovens have had to design their own. However, standard equipment is becoming available from several manufacturers, and this should cause a change in the industry picture.

Fiber Characteristics

Continuously bonded non-wovens tend to display more of the properties of the bonding material. For this reason more consideration must be given to the choice of binder system to be used so that the desired fabric characteristics may be obtained.

Goodyear technicians point out that the choice of suitable drying equipment for non-wovens must depend on several factors:

(1) The web as received from the saturating unit has no strength and usually is supported on a belt through the dryer.

(2) Stretch applied during the drying will cause permanent distortion of the web.

(3) Many binder systems require a cure, and provision should be made for both drying and curing.

(4) Adequate exhaust systems are essential since ingredients in some binder systems are driven off during the drying and cause unpleasant working conditions.

(5) Migration of the bonding material can give trouble, but can be prevented by drying conditions which allow transfer of heat to the center of the web before the outside dries significantly. Dryers that draw air through the web or those with a low temperature or steam-saturated entering section are helpful.

In the adjustment of most saturating equipment, Goodyear points out, there is a narrow range of wet pick-ups where most efficient operation is obtained. To control the amount of dry binder deposited in the web, it is better to vary the solid contents of the saturating bath, rather than to change the wet pick-up.

The shape of the lady is her own. The shape of the dress is due largely to an interlining of Pellon, a nonwoven fabric.

Techniques for curtain wall panel bonding adapted to . . .

Chemical Fastening of Desk Tops

As the result of some imaginative inter-industry rubber-necking, leading manufacturers of office furniture are reaping high dividends in increased production line efficiency and speed. For example, at Columbia Steel Equipment Co., Fort Washington, Penna., thermoplastic bonding techniques originally developed for curtain wall sandwich panels used in building construction have been successfully adapted to high-speed assembling of linoleum-topped desks.

Surface Blisters

One of the problems plaguing the office furniture industry is the incidence of surface blisters resulting from the expansion or shifting of the linoleum during the bonding operation. Production engineers are, therefore, constantly on the alert for new bonding systems and materials which eliminate this danger.

A study of considerations bearing on sandwich panel construction convinced Columbia Steel engineers that many of the factors were similar to those affecting desk-top assembly. They decided, therefore, to adapt panel bonding procedures to their own production facilities.

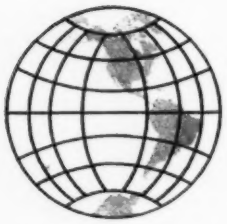
The production line setup worked out is as follows:

Both the desk top and the underside of the linoleum top are spray-coated with Bondmaster G592, a neoprene-based adhesive originally developed by Rubber & Asbestos Corp. for sandwich panel bonding. To protect the desk's metal edge-stripping, it is masked.

Next, a battery of 36 infrared lamps are used to force-dry the coated linoleum and desk top. This operation drives off all solvent and heats the adhesive film so that it is thermoplastic and tacky. The linoleum and desk top are then mated as quickly as possible.

Adjustment Problem

Because the adhesive bonds quickly and strongly, there is little possibility for adjustment once the parts are positioned. Allowance is made for human error by cutting the linoleum slightly oversized. It can then be scribbled to fit within the desk's heading strip and the excess broken away. Finger pressure fits the cut edge into place within the heading.



NEWS of the ADHESIVES WORLD

Adhesives Program Of Gordon Conferences

The Gordon Research Conferences for 1959 on the Chemistry of Adhesion will be held on August 31-September 4 at New Hampton School, New Hampton, New Hampshire, while the Chemistry of Elastomers conferences will be held on August 10-14 at Colby Junior College, New London, New Hampshire. The program for the Adhesion Conferences is:

August 31—"Surface Behavior as Affected by Internal Organization of Solids," by R. Oriana; "Adhesion Characteristics of Cellulosic Materials," by B. G. Ranby.

September 1—"Surface Properties and Types of Bonds Involved," by J. E. Rutzler; "High Temperature Creep Measurements as a Means of Estimating Surface Free Energy," by W. E. Holland and J. D. Haygood.

September 2—"Molecular Interactions with the Surfaces of Solids," by R. L. Patrick, C. A. Kumins and M. Gottlieb; "Adsorption of Polymers," by R. R. Stromberg.

September 3—"Factors Affecting Adhesion of Epoxy and Polyester Systems to Glass," by F. J. McGarry; "Adhesion Properties of Carbohydrate Systems," by C. G. Caldwell.

September 4—"Mechanics of Adhesive Bonds." "Influence of Adhesive Physical Properties on Bonded Joint Behavior," by A. F. Martin; "A General Theory of Peel Adhesion," by D. K. Kaelble.

The Elastomers Conference schedule is:

August 10—"A New Technique for Measuring Volume Swell and Its Application to Elastomer Studies," by J. P. Buckley and M. Berber; "Solubility and Viscosity Characteristics of Elastomers," by A. R. Kemp; "Frictional Properties of Flexible Vinyl Polymers," by R. Norman.

August 11—"The Attrition of Carbon Black: Surface Chemistry and Reinforcing Effects," by A. M. Gessler; "Properties of Attrited Carbon Black," by E. M. Dannenburg; "Elastomers for High Temperature Services," by E. R. Bartholomew.

August 12—"Observations on Tire Performance," by R. D. Stichler; "Resilience and Power Loss of Elastomers," by A. D. Dingle et al.

August 13—"Colloidal Properties of Synthetic Latices," by C. F. Fryling.

August 14—"Vinylic Filler Reinforcement of Elastomers," by Oliver Burke and Eldon Stahley.

Requests for attendance at the conferences, or for additional information, should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R.I.

Johns-Manville Merger

L. O. F. Glass Fibers Co. has been merged with the Johns-Manville Corp. to form Johns-Manville Fiber Glass, Inc., in Toledo, Ohio. According to the firm, this merger will greatly improve manufacturing opportunities for the company and will permit further expansion in the fiber glass industry. Any and all purchase orders issued prior to January 1, 1959, will remain in effect and all conditions stated on face of the purchase order remain the same. Fundamentally, the firm will operate as before and previous contacts with plant personnel will remain the same.

Avco Sells Plant

Avco Manufacturing Corp., Cincinnati, Ohio, has announced that it has sold a plant in Carrollton, Ky., that makes cabinets and furniture to a syndicate headed by Victor Muscat, president of Victor Industries Corp., Greenwich, Conn. The plant, one of four facilities of Avco's Crosley Division, has 114,000 square feet of floor space and employs 300 persons.

Chemical Construction Sets Record in 1958

Manufacturing Chemists' Association, Inc., Washington, D.C., has reported in its annual construction survey that privately-financed chemical production facilities costing a record total of $1.775 billion were completed, in the U.S. during 1958. Included in this outlay was approximately $70.145 million spent to complete construction of chemical research laboratories.

The MCA also announced that an additional $1.054 billion will be spent for production projects now underway and $464.090 million for projects scheduled for groundbreaking in the near future and completion before 1961. This brings the total chemical plant construction to an estimated $3.293 billion for the three-year survey period, 1958-60. The report also shows that research expenditures for the construction of new laboratories in 1959 and 1960 will be at least $87.025 million. The total expenditures for chemistry laboratories for the three-year period amounts to $157.170 million.

The combined three-year production facilities expenditure represents a total of 802 projects by 287 companies in 432 communities of 43 states. The record posted for completed construction in 1958 includes 498 projects carried out by 251 producers in 303 communities of 43 states. The 216 projects already underway by 98 companies are in 142 communities of 33 states. The planned construction by 58 firms of 88 additional projects—scheduled also for completion by the end of 1960—will be in 73 communities of 25 states.

Basic Research Costs

According to the MCA, the chemical industry's expenditures for basic research alone—the "pure" research conducted with no immediate commercial objective in mind—represent about ten per cent of the industry's over-all research budget. The National Science Foundation has reported that the chemical industry's basic research program accounts for about 25 per cent of the cost of all basic research financed by all U.S. industry.

The MCS survey is based on activity within the chemical industry itself and on the chemical operations of firms, such as the oil and rubber companies, primarily associated and identified with other industries.

Adhesives Session At 44th TAPPI Meeting

Almost 300 paper technicians and production men jammed a special Adhesives Testing Session featured on the program of the 44th annual meeting of the Technical Association of the Pulp and Paper Industry held at the Hotel Commodore, New York City, February 23-26. The special session, prepared by members of TAPPI's Testing of Adhesives Committee, took place on the morning of February 24th.

William H. Neuss, Stein, Hall & Co., Long Island City, served as chairman of the session. Speakers included H. J. Ladue, American Paper Bottle Co., Walled Lake, Mich.; H. G. Maeder, Dixie Cup Div., American Can Co., Easton, Penna.; and Dr. Herman Mark, Polytechnic Institute of Brooklyn, N.Y.

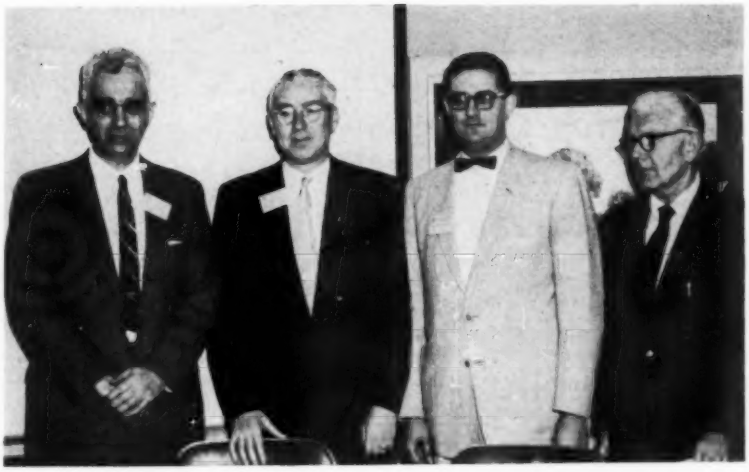
In his introductory remarks, Mr. Neuss, who is also chairman of the Testing of Adhesives Committee, pointed out that the purpose of the committee and this special session was to spotlight specific industry problems and their solutions. Members of the audience were invited to suggest papers to be featured at future meetings.

Discusses Glueability

Choosing as his topic "Predicting the Glueability of Milk Carton Stock Board," Mr. Ladue described a series of tests undertaken by the American Paper Bottle Co. He pointed out that much of the company's investigation to date had been concerned with measuring the strength of bond between paper and a standard Dennison wax stick. An Instron tensile tester was used in these studies.

Areas of investigation have included wax stick selection, the effect of wax temperature at the time of bond, the effect of pressure applied to the stick in preparing a sample, the effect of the bond area, and reproducibility of results. Other testing methods being studied, Mr. Ladue noted, are the standard Dennison wax pick test, a rate of set test, the Cobb size test, the absorbency test and the Penescope test.

"Evaluating Industrial Adhesives" was the title of Mr. Maeder's talk. He began by pointing out that only adhesives for paper bonding would be considered. In line with this, he decribed a simple viscometer developed by American Can technicians as an aid in predicting adhesives behavior in a paper converting operation.



Shown at the Adhesives Testing Session of the 44th annual TAPPI meeting are (left to right) W. H. Neuss, Stein, Hall & Co.; H. G. Maeder, Dixie Cup Div., American Can Co.; H. J. Ladue, American Paper Bottle Co.; and Dr. H. F. Mark, Polytechnic Institute of Brooklyn.

Recent critical laboratory examination of the rheological behavior of certain industrial adhesives, Mr. Maeder emphasized, has led to a close correlation with machine performance. Therefore, measurements made under conditions simulating actual use take nearly all of the uncertainty out of conventional adhesive testing procedures.

Speaking on "Adhesion," Dr. Mark noted that good adhesion requires the combination of two factors: (1) rapid establishment of a large contact area between adhesive and substrate, and (2) the formation of strong bonds between these two components of the cemented systems. The successful combination of these conditions, he explained, depend on the following molecular characteristics of the adhesive:

(1) The chains of the polymer used must have a high degree of internal mobility. In this way, they diffuse rapidly at the substrate surface and establish a large contact area in a short time at a given temperature.

(2) These chains must carry a sufficient number of polar or, preferably, hydrogen bonding groups which are capable of establishing strong intermolecular bonds.

After each of the three talks, the session was thrown open to questions.

New Air Reduction Unit

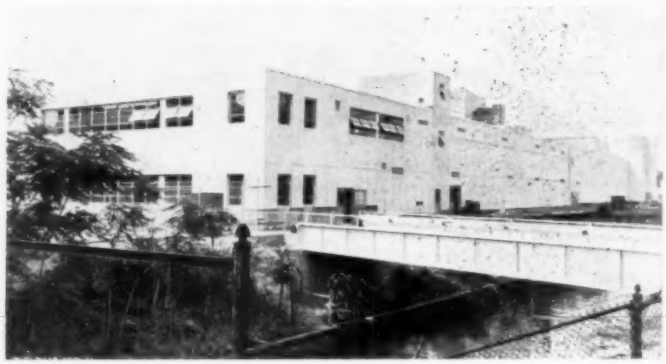
Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York, N. Y., has completed a new facility for the production of oxygen and nitrogen at 1100 Packard Street in the Armourdale district of Kansas City, Kansas. The new plant replaces an Air Reduction facility located in Kansas City, Mo., which has been closed. The company's district offices, storeroom and Engineering Services Department remain at 2701 Warwick Trafficway, Kansas City, Mo. The new plant, which was designed to expand capacity to serve users of industrial gases located within a 300 mile radius of Kansas City, makes high purity oxygen and nitrogen.

National Starch Sales Up

National Starch Products Inc., reported record sales and earnings for the year which ended December 31, 1958. Net earnings after taxes amounted to $3,130,667 or $3.17 per common share, compared with $2,676,535 or $2.72 per share in 1957. The 1958 earnings include a non-recurring credit equivalent to 23¢ per share, reflecting the use of a tax carry-forward loss incurred by Granite Board Inc., prior to its consolidation into National Starch Products.

The increase in earnings were attributed mainly to profitable new products recently developed by the company's research and development program.

Goodrich Opens Adhesives Plant in Akron



B.F. Goodrich Industrial Products Co., Akron, Ohio, a division of B.F. Goodrich Co., has announced the formal opening of its $2.5 million adhesives plant in Akron. The two-story plant had been under construction since late 1957, and is specially designed for the manufacture of adhesives. It has 70,000 square feet of floor space and will be operated by a staff of about 100 persons. In addition to production facilities, the plant houses a development laboratory which, it is reported, will enable the company to offer rapid service in the development of adhesives to meet a customer's special needs. The company states that the new plant will produce anything in adhesives from stationery cement for the office, to tough adhesives for putting airplanes together, and bonding automotive brake linings as well as in many other industrial applications.

Pilot plant section of the development laboratory. In foreground is a variable speed mill which processes rubber. Curing presses in rear bond various materials with experimental formulations.

Tailor-made adhesives, developed to meet customers' special needs, are made in this area of the development laboratory. Experimental formulations are shown being prepared.

Dextrinization Process

A. E. Staley Manufacturing Co., Decatur, Ill., has reported the development of a new dextrinization process which promises cleaner, lighter-color, more uniform and specification-sure dextrins. According to the company, the new process "fluidizes" dry powdered starch by air flow to permit an extremely even distribution of heat and acid to each particle of starch for conversion to dextrin, and the conversion is much more uniform than with conventional batch dextrinization. The new dextrins also tend to be lighter in color and are cleaner, because the process is free of localized acidity concentrations which sometimes cause the starch to char in conventional conversion methods, the company states. Staley expects the principal application to be in the paper industry for coating, in bag pastes and prepared adhesives, and in the textile industry for print thickener, finishing and dyeing.

Spitzer Named President

Interchemical Corp., New York, N.Y. has announced the appointment of Francis A. E. Spitzer as president of its International Division. He succeeds Joseph G. Morris, who is relinquishing his executive position in accordance with the company's retirement policies. Mr. Morris will continue to serve the International Division on special assignments. Mr. Spitzer has been associated with Interchemical for 20 years.

Uses New Drum Lining

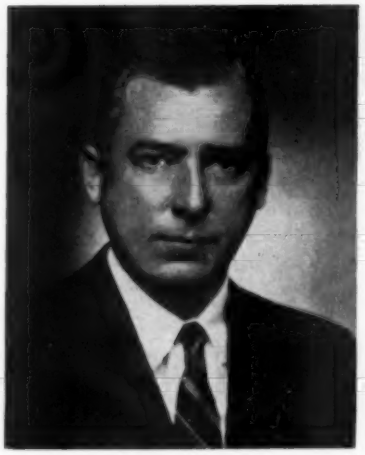
National Casein of New Jersey has initiated the use of specially lined, 55-gallon drums for the packaging of the catalyst component of the urea formaldehyde resin adhesive manufactured at the company's Riverton, N. J., plant. Urea formaldehyde resin adhesive is used extensively in bonding laminated plywoods and other wood assemblies. For best performance, it must be used within a relatively short time after formulation. To assure customers of fresh and full-strength liquid adhesive materials, National Casein produces them only after receipt of orders. The two components are shipped in separate containers. The adhesive material presents no particular packaging problem. The catalyst, which is mixed at the time of application, presents a packaging difficulty because of its reaction with steel.

National Casein invited drum suppliers to run tests to determine the right protective container for the catalyst. The company required a container that would prevent a reaction with steel and provide a positive seal against loss of gaseous ammonia. The Container Division of Jones and Laughlin Steel Corp. solved the problems and now supplies all drums used for the catalyst. The J & L drums have a specially compounded, pigmented phenolic lining, which is applied by advanced techniques that assure a continuous, tightly bonded internal "envelope" for the product, the company states.

Borden Earnings Up

Borden Co., New York, N.Y., has announced that its earnings in 1958 were $24,612,475, a 2.6 per cent increase from the 1957 figure of $23,996,312. The 1958 earnings are a new high mark for the third successive year. Earnings per share of common stock in 1958 equaled $5.06, compared with $4.94, the 1957 figure after adjustment for a four per cent stock dividend paid January 3, 1958.

Sales in 1958 declined 1.7 per cent, to $915,024,172 from 1957's all time high of $931,220,662. A company spokesman said that the most important of several factors in the sales decline was the withdrawal from certain lines of distribution which had been unprofitable. The 1958 rate of profit was 2.7¢ per dollar of sales, compared with 2.6¢ a year before. Federal income taxes were $21,632,971 for 1958, compared with $22,146,164 for 1957.



Kenneth Arnold

John R. Lindquist

Stein, Hall Appoints Two

Stein, Hall & Co., Inc., New York, N.Y., has announced the election of Kenneth Arnold as a vice-president, and the appointment of John R. Lindquist to the managership of the firm's Paper & Corrugating Department. Mr. Arnold, who joined the company in 1933, has been manager of the Paper & Corrugating Departments since 1957. Former positions with Stein, Hall included the managership of the Paper Mills Department as well as of the company's Chicago branch sales office.

Mr. Lindquist is a graduate of the University of Illinois and previously served Stein, Hall as a sales representative in the Chicago office. He then served as assistant to the manager of the Paper & Corrugating Department.

New Research Supervisor

Shell Development Co., Emeryville, Calif., has announced the appointment of Dr. R. W. Tess as research supervisor at its Emeryville Research Center. Dr. Tess will supervise the research activities of the surface coatings group in the firm's Plastics and Resins Department. He is a graduate of the University of Illinois, receiving his B.S. degree in chemistry in 1939. In 1955 he received a Ph.D. in organic chemistry from the University of Minnesota, and joined the staff of Shell's Emeryville Research Center the same year.

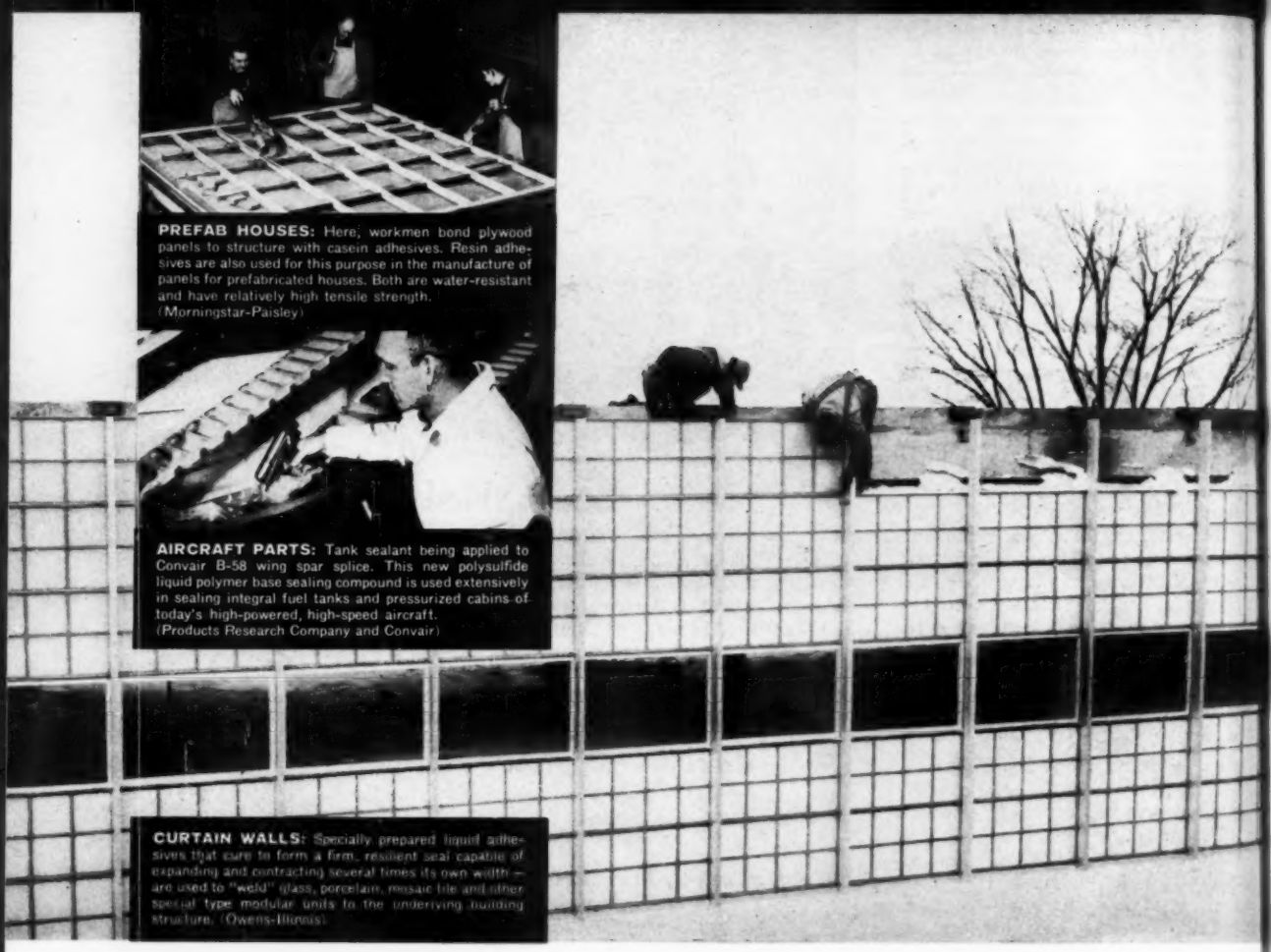
A-D-M Names Davis

Archer-Daniels-Midland Co., Minneapolis, Minn., has named Willard J. Davis, formerly assistant treasurer, to the post of treasurer, succeeding Sims S. Adair, who has retired after 42 years of service. The company also has announced the appointment of Arnon L. Lundberg to the New York sales staff.

Epoxy Curing Liquid

Heyden Newport Chemical Corp., New York, N. Y., has announced the availability of Beta-S, a new liquid dicarboxylic anhydride, in development quantities. The company reports that testing shows the product to be particularly useful in curing epoxy resins. Beta-S, dimethyl substituted butenyl tetrahydro phthalic anhydride has a combination of double bond and anhydride functionality indicating potential as an intermediate for preparing surfactants, lubricant additives, corrosion inhibitors, dyes, fungicides and inks, the company stated. Heydon reports that as a curing agent, Beta-S is suitable for systems used in impregnating, potting, casting, laminating, tooling and coatings. Physical testing by Heyden shows epoxy systems cured with the anhydride to possess high compressive and flexural strengths, low power factor characteristics, low shrinkage, and, in addition, low exotherm evidenced by the anhydride in casting operation is conducive to plant safety

ADHESIVES ⇨ ⇨ NEW MARKET



PREFAB HOUSES: Here, workmen bond plywood panels to structure with casein adhesives. Resin adhesives are also used for this purpose in the manufacture of panels for prefabricated houses. Both are water-resistant and have relatively high tensile strength. (Morningstar-Paisley)

AIRCRAFT PARTS: Tank sealant being applied to Convair B-58 wing spar splice. This new polysulfide liquid polymer base sealing compound is used extensively in sealing integral fuel tanks and pressurized cabins of today's high-powered, high-speed aircraft. (Products Research Company and Convair)

CURTAIN WALLS: Specially prepared liquid adhesives that cure to form a firm, resilient seal capable of expanding and contracting several times its own width — are used to "weld" glass, porcelain, mosaic tile and other special type modular units to the underlying building structure. (Owens-Illinois)

A multi-million dollar sales opportunity for 1959!

Bootmakers, boatmakers, bookbinders, lumber companies, tile companies, publishing companies, manufacturers of jewelry, furniture, toys, insulation, matches, paper tubes, models, luggage, aircraft parts, labels, paper boxes, flooring.

These are just some of the thousands of companies across all industry who are, today, a great and growing market for adhesives and adhesive products of every kind. A market for machinery and equipment. A market that you can reach, as a single market, for the first time in ADHESIVES AGE . . . the magazine of the industry!

Here is a partial list of the important companies who are already using—and will be using—ADHESIVES AGE in 1959, to tell the story of their products and services to this multi-million dollar market:

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If you sell adhesives, or adhesive products . . . or the materials, machinery, equipment, supplies and services used to make, ship, store or apply adhesives . . . be sure to include ADHESIVES AGE in your 1959 advertising.

Ask for a copy of the report: ADHESIVES AGE—Market and Magazine . . . including material from basic Mills Shepard research.

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ADHESIVES AGE NEW MAGAZINE

1958 Air Exhibit

The 1958 Air Exhibition, held recently in Farnborough, England, is said to have shown the steady progress made by the British aircraft industry in all fields. Among the exhibits were some of particular interest in the field of adhesives. B. B. Chemical Co., Ltd., displayed its Bostik adhesives and sealing compounds of all types. These are used for sealing integral fuel tanks and pressurized cabins; glazing laminated screens; upholstery trimming; and building and maintenance operations requiring specialized adhesives and sealing compounds.

Ciba (ARL) Ltd., showed its Redux and Hidux adhesive systems for load bearing metal structures. The firm also demonstrated Aeroweb lightweight honeycomb core materials and Araldite epoxy resins for glasscloth laminates, surface coatings, electrical insulation, tools, patterns and jibs. EMI Electronic, Ltd., had exhibits including a specially developed epoxy resin potting unit designed to carry out all operations in a vacuum. Another company whose exhibits included resins was Aeroplastics, Ltd., which featured glass and other fabrics impregnated with a range of synthetic resins.

Case Building Plant

Case Paper Co., New York, N.Y. has announced that construction has started on a new warehouse and office building at Borden Avenue, Long Island City, N.Y. According to Case, the 100,000 square foot building is scheduled for completion about June 1. The building's ground floor space of 90,000 square feet has been set aside for storing paper under carefully regulated conditions. Temparature will be individually controlled in warehouse, cutting rooms and offices. The company reports that cavity-wall construction will insure dry walls at all times and floors will be specially treated to prevent dust under heavy truck traffic.

The building includes a completely enclosed truck bay which will accommodate eight 50-foot trailers at one time, and a 250-foot railroad siding will connect with the Long Island Railroad. Some 10,000 square feet of space have been set aside for clerical and administrative use. The building is being set on a 150,000 square foot plot, and 15,000 square feet have been set aside for parking facilities, and an additional area has been reserved for future expansion.

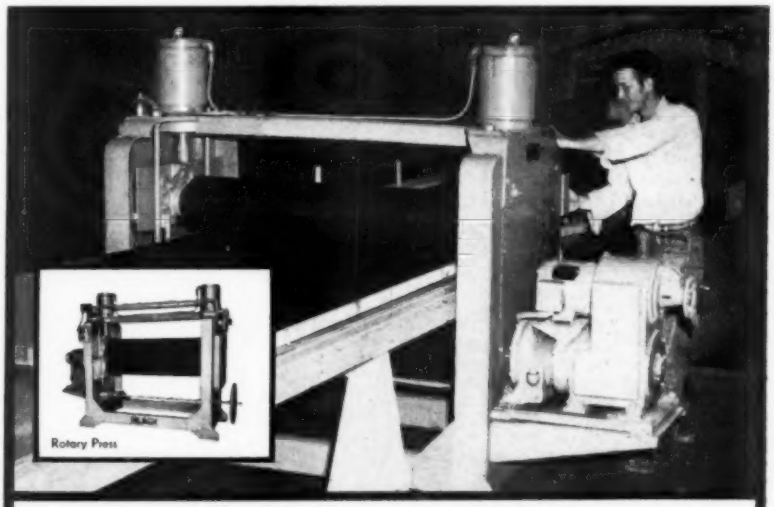
New Bond Testing Method

W. C. Dillon & Co., Inc., Van Nuys, Calif, has announced the development of a new method of measuring the bond strength of almost any material. According to Dillon, by combining a Dillon Dynamometer with a screw jack and materials found in almost any metalworking shop, a highly efficient tensile tester can be easily and inexpensively fabricated. The portable instrument can be used to measure the strength of resinous materials such as asphalt, concrete, or any sheet material such as metal, wood or fiberglass, or to test the holding power of glues, motars or even mechanical fasteners, the company states

Dillon reports that the testing assembly consists of two parts: (1) a hook with a plug that is anchored within or on the underside of the material to be tested, and (2) a Dillon Dynamometer integrated with a screw jack. The latter assembly is placed over the anchored hook so that the hook and the Dynamometer clevis are joined. The jack is turned slowly until the material being tested gives way. The Dynamometer, at that moment, gives the actual bond or tensile strength in pounds.

Sells Dryer Rights

Foster D. Snell, Inc., New York, N.Y., has announced the sale of world-wide manufacturing rights of the Snell Spray Dryer to Bennett Son & Shears Ltd, London, England.



BLACK BROTHERS COLD PRESSES, For Fast Efficient Moderate Pressure Laminating

Here's the *economical way* to meet the challenge of new adhesives and hold the line on ever-increasing manufacturing costs. Black Brothers' cold presses are especially designed to make efficient use of both manpower and floor space. They're fast, accurate, versatile — incorporate the most up-to-the-minute features for speeding work through modern laminating processes. Specific product bulletins will give you complete details. *Write for them today.*

ROTARY PRESS (Above) Here is automation in lamination . . . the ideal press for laminating dissimilar plies when bonding with rubber base contact cements and adhesives. Increased pressure efficiency and faster production are two prime advantages of this press which is available in capacities to 122". Pressure can be furnished by either pneumatic cylinders or large adjustable pressure springs. *Bulletin 11-C*

THE BLACK BROTHERS CO., INC.—MENDOTA, ILLINOIS

AIR HOSE LAMINATING PRESS
Low cost, high production press for moderate pressure laminating operations with fast-setting vinyl and protein latex type glues. Sizes from 30" x 30" to 62" x 120" platens.
Bulletin 11-D.

MOTORIZED LAMIMATING PRESS
A fast, efficient press for moderate pressure laminating. Usable with or without retaining clamps and I-beams. Low initial cost, rugged construction make it a smart investment. Sizes from 36" x 36" to 58" x 200".
Bulletin 11-E

Adhesive Joints Course

The Massachusetts Institute of Technology has announced that an intensive course on adhesive joints will be given on June 29 to July 3, 1959. Topics to be discussed at two daily sessions of three hours each will include: solid surfaces, wetting, application of adhesives, tackiness, setting, testing of joints, stress concentration of joints, plastic and elastic adhesives, final strength and bulk strength, and the rheology of peeling and scraping. The lecturers will include both university and industrial scientists, namely, A. G. H. Dietz, F. J. McGarry, J. J. Bikerman and W. G. Moffatt, all from M.I.T.; C. Mylonas from Brown University; and W. K. Asbeck, S. Twiss, and F. Wetzel from industry. The audience, limited to 30 persons, presumably will consist of graduate chemists, physicists and engineers familiar with formulation or application of adhesives and feeling a need for understanding the basic phenomena and the modern developments of the science of adhesive joints. Application for entry to the course should be submitted to the Office of Summer Session, Massachusetts Institute of Technology, Cambridge 39, Mass.

Fome-Cor Corp. Formed

St. Regis Paper Co. and Monsanto Chemical Co. have announced the formation of the Fome-Cor Corp., a jointly-owned company which will manufacture and market Fome-Cor, a foamed plastic and paper sandwich material. The new company currently is producing the product in three grades on a semi-commercial scale at the Superior Paper Products Co. plant of St. Regis at Mt. Wolf, Penna. A new and larger production unit adjacent to Monsanto's facilities is under construction at Addyston, Ohio, and is expected to be in production in the near future.

Epoxy Resins Symposium

Reichhold Chemicals, Inc., recently held a symposium on Epotuf epoxy resins at the RCI Plasticenter, Elizabeth, N.J. A group of surface-coating formulators attended this first symposium at which a general review of epoxy characteristics and chemistry provided the background for specific data on surface coating formulations using RCI's Epotuf epoxy resins.

Offers Plastoglass

A material composed of glass fiber and vinyl sheeting has been introduced by Storey Bros. and Co., Lancaster, England. Called Plastoglass, the material is produced by adhesion between glass fiber and reinforced vinyl film. Though the combination is not new, the technique employed for the production of Plastoglass is said to be an improvement on the conventional method of placing a layer a vinyl film on a layer of fiber.

Plastoglass is produced by taking a fine net of glass fiber and then placing it between two sheets of vinyl film. The next process is to fuse the two sheets together. The narrow gauge of the glass threads used in the fiber is an important factor as it is said to remove much of the brittle quality of normal fiber. The company states that Plastoglass is resistant to mildew, rot and fire, weathering and acids; is attractive in appearance; and is suitable for color printing.

Borden Appointments

Borden Chemical Co., New York, N.Y., has announced the appointment of Donald R. Long as plant manager of its operation in Illinois, Ill. Mr. Long, formerly plant superintendent at Borden's Polyco-Monomer operation in Leominster, Mass., will be assisted by R. M. Austin, who has been named area superintendent. J. D. Kirby will be production engineer. The company also has announced the appointment of D. O. Twiss as assistant plant superintendent and C. B. Wyman as process engineer, both at Leominster.

"Tastes like glue!"

Offers Ceramic Foams

Emerson & Cuming, Inc., Canton, Mass., has introduced two series of ceramic foams for electrical and electronic use. Both materials, Eccofoam LM-43A and Eccofoam WC-8, are light in weight and capable of use in excess of 1000°F., the company reports. Eccofoam LM-43A is supplied at dielectric constants of 1.3, 1.4, 1.5 and 1.6, with a dissipation factor below 0.001. Eccofoam WC-8 is supplied at dielectric constants 1.7, 1.8, 1.9, 2.0, 2.5, 3.0, 4.0 and 5.0, and the dissipation factor is well below 0.003. The LM-43A materials are below 20 pounds per cubic foot while the WC-8 series varies from about 20 to 70 pounds per cubic foot dependent upon dielectric constant. The company reports that for both materials, the flexural strength remains high even at 1000°F. and that the foams can be fabricated readily with standard tools. Emerson & Cuming states that these ceramic foams can be used in antennas, radomes, lenses and as dielectrics in microwave systems. They supplement the standard Eccofoam line of adjusted dielectric materials and extend the temperature range of use.

Container Corp. Sales Up

Container Corp. of America, Chicago, Ill., has announced that its sales for 1958 amounted to $259,271,078, compared to $256,115,744 in 1957, an increase of 1.2 per cent. Net earnings after all charges, including provision for depreciation, federal, state and local taxes, were $14,513,972, compared to $14,589,692 for the previous year. After provision for preferred dividends the net earnings equaled $1.35 per share of common stock, compared with $1.36 in 1957.

Expands Activities

Avco Manufacturing Corp., Cincinnati, Ohio, has announced that new and expanded infrared activities have been undertaken by its Crosley Division. According to the company, Crosley's efforts in the infrared field included such broad areas as surveillance, ICBM detection, fire control, mapping and other commercial applications. A company spokeman declared that Crosley is giving its infrared systems group the fullest management support, in view of the project's importance.

Sales Increase Forecast

Dewey and Almy Chemical Division of W. R. Grace & Co., Cambridge, Mass., expects major existing markets for its organic chemicals, taken as a whole, to "nearly double" in the next five years. This was disclosed by Charles E. Brookes, organic chemicals sales manager, at an annual sales meeting which included 100 employees of the Organic Chemicals Division and others at Dewey and Almy who work closely with organic chemicals. Mr. Brookes predicted that with "solid performance by the sales force in the field" sales will triple in the same period. It is expected that products now in planning or developmental stages will account for sales equal to those resulting from growth of existing markets, he said.

The group also received a first-hand summary of 1958 activities and an announcement of 1959 objectives from Thomas G. Gibian, organic chemicals general manager. The fields served by Dewey and Almy's Organic Chemicals Division include adhesives, paints, papers, textiles, rubber and plastics. Product lines are polymers, butadiene-styrene latices polymers, butadienestyrene latices and resins, plasticizers, and dispersing agents.

Morningstar Exhibit

Morningstar-Paisley, Chicago, Ill., has announced that a full complement of its technical, research and sales personnel will be on hand, to discuss the company's complete line of adhesives and plastisols for packaging operations, at the International Amphitheater in Chicago during the AMA National Packaging Exposition from April 13 through April 17. According to the company, the exhibit will feature instructive panels and displays in active areas of coating, adhesive and plastisol applications. Technical personnel will be glad to answer visitors' questions.

Measurement Methods

Committee C-19 on Structural Sandwich Constructions of the American Society for Testing Materials has approved methods relating to the measurement of creep characteristics of sandwich constructions loaded in flexure at any desired temperature. Two methods are being developed to determine the resistance to peel of the bond between metal facings and core. One of these methods involves the use of the 4 inch diameter hand or drum peel tested.

AviSun Company Formed

American Viscose Corp. and Sun Oil Co. have established an equally owned affiliate, AviSun Corp., located in Phladelphia, Penna. According to the parent companies, AviSun will be an integrated company for the manufacture, processing and sale of polypropylene resins, film, fibers, elastomers, surface coatings and adhesives using olefin polymers or copolymers with other substances. It is reported that commercial quantities of polypropylene resin are expected to be available by mid-summer from leased facilities of the Port Reading, N.J., linear polyethylene plant of Koppers Co., Inc. The capacity of the converted plant is estimated to be 20 million pounds per year.

Chalmer G. Kirkbride, executive director of research and engineering for Sun Oil, has been elected president of AviSun; William H. Brown, vice-president and treasurer of Viscose was elected treasurer and assistant secretary; and Joseph R. Wilson Jr., assistant secretary and assistant treasurer for Sun Oil, has been elected secretary and assistant treasurer of the new affiliate.

Adhesive Data Chart

Flexcraft Industries, Newark, N.J., has announced the availability of its comprehensive Adhesive Data Chart which covers a broad line of industrial adhesives, including water base resin, solvent and solvent base resin, hot-melt and epoxy, their characteristics, uses and methods of application. According to Flexcraft, the layout of the chart makes it easy to quickly locate a selection of adhesive for almost any specific purpose, including the bonding of difficult dissimilar materials. The chart can be obtained by applying on company letterheads to Flexcraft Industries, 527 Avenue P, Newark 5, N.J.

Earnings Up For 1958

Interchemical Corp., New York, N.Y., has announced that its 1958 earnings were up 19.3 per cent over the 1957 level, although sales were about equal for the two years. Net earnings for 1958 amounted to $4,684,000, equal to $5.38 per share of common stock, compared with $3,924,731 or $4.43 per share. Sales in 1958 totaled $109,489,000, compared with $109,846,686 for 1957. Earnings before taxes were $9,586,000 for 1958, against $7,944,731 in 1957, while Federal income taxes were $4,902,000 in 1958, compared with $4,020,000 for 1957.

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INDUSTRIAL ADHESIVES
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CEMENTS for BONDING
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PAPER TO FOIL
PAPER TO POLYETHYLENE
CLOTH TO CLOTH
POLYETHYLENE TO CLOTH
CLOTH TO LEATHER
LEATHER TO LEATHER
LEATHER TO RUBBER
RUBBER TO RUBBER
RUBBER TO METAL

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FOR BONDING
DECORATIVE LAMINATES
THAT ARE WATER
AND HEAT RESISTANT

TAILOR MADE
ADHESIVES
FOR INDUSTRY
NATURAL AND
SYNTHETIC LATEX, AND
SOLVENT RUBBER CEMENTS,
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In these practical ways, the UN brings new hope and happiness into the lives of peoples less fortunate than we are—at the same time cuts down the discontent that could easily erupt into another war.

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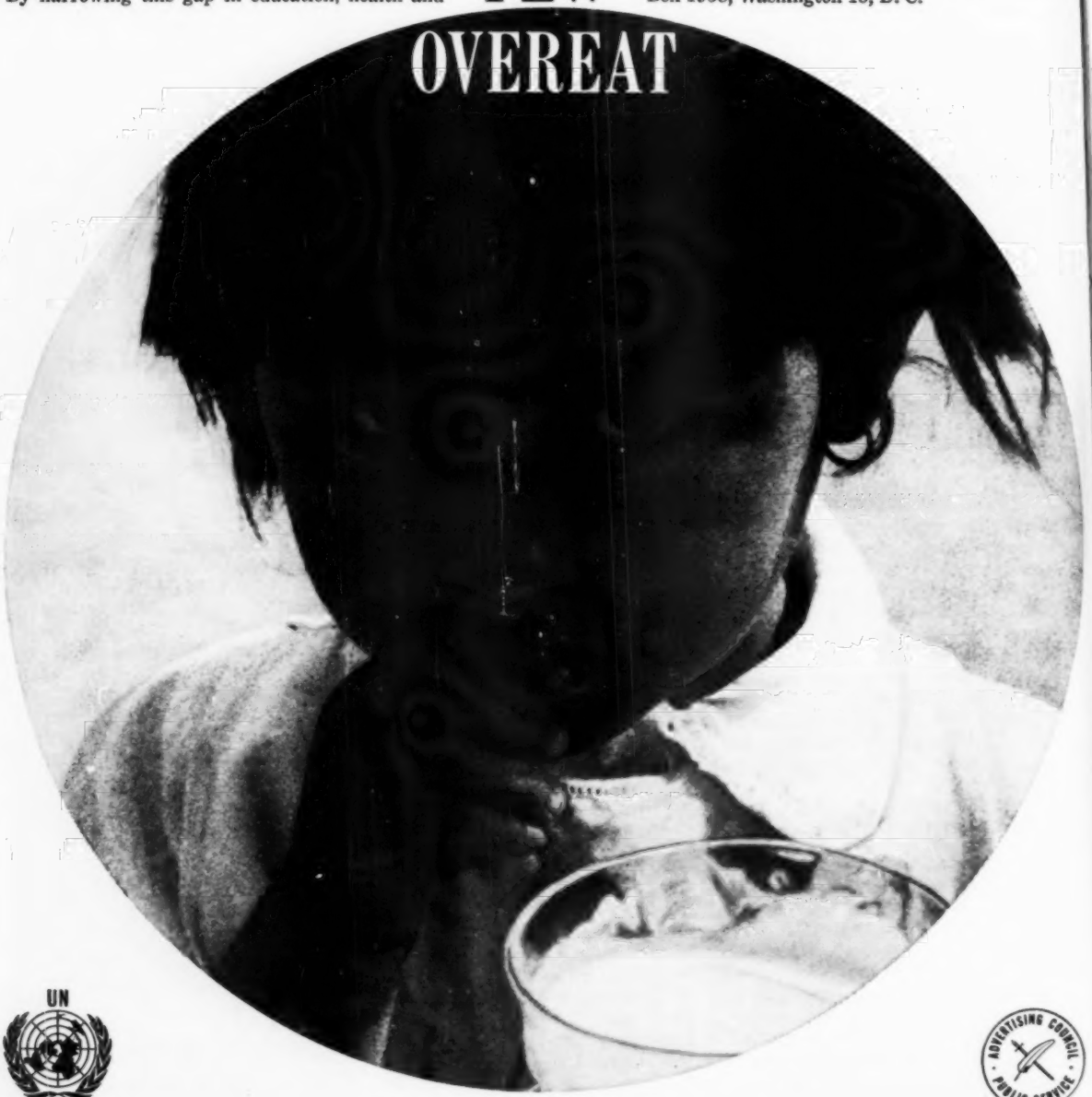
Be an ambassador of the UN in *your* community. The world's leaders actively support the UN...but *your* good will, understanding and support are the best guarantees of its success. For the informative free pamphlet "The UN in Action," address: United States Committee for the United Nations, Box 1958, Washington 13, D. C.



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Packaging Show Planned

The Fifth International Packaging Exposition, Europak 1959, scheduled to be held on April 21 to 28 at the RAI exhibition building in Amsterdam, The Netherlands, has attracted a great deal of interest from countries all over the world. Europak 1959 is expected to take on added significance because of the recent establishment of the Euromarket. Many manufacturers believe that this is an advantageous time to introduce their equipment.

Manufacturers from 16 countries have already reserved space, with the largest number to date from Great Britain, which will be represented by 75 firms. West Germany will have 58 exhibitors; the United States 26; Belgium 14; France 11; and Italy 5. Other countries participating will include Denmark, East Germany, Sweden, Finland, Norway, Austria, Canada, Czechoslovakia, Switzerland and Venezuela.

The exposition has been held every other year since 1951 and it was decided to name this year's exposition Europak 1959 because of its growth into one of Europe's largest packaging expositions. Attendance at the last exposition was estimated at from 25,000 to 30,000 with more than 3000 overseas visitors. Although the deadline for receipt of applications for space was set for the end of March, organizers report that practically all space has been reserved. American firms interested in applying for space should get in touch immediately with Europak, Tesselschadestraat 5, Amsterdam, The Netherlands.

Isochem Names Jacobs

Isochem Resins Corp., Providence, R.I., has announced the appointment of Paul D. Jacobs as its resident sales engineer in California, with field offices at 420 Market St., San Francisco. Mr. Jacobs formerly was with Northwestern Plastics Co. where he was engaged in technical sales duties. He will direct the technical sales and service program for the entire line of Isochem products, including Isogel epoxy dip coating resins; Isocast epoxy potting compounds, Isobond adhesives; impregnating resins.

Chemical Education

The Massachusetts Institute of Technology, Cambridge, Mass., has announced that it has joined forces with Esso Standard Oil Co. and American Cyanamid Co. in an unusual educational venture to provide professional education for young chemical engineers.

M.I.T. now has 20 students assigned to projects at two New Jersey plants. Half of the students are at Esso's Bayway Refinery in Linden, and the others are at American Cyanamid's Bound Brook organic chemicals plant. After approximately nine weeks of intensive work, the groups will exchange stations, and continue for another nine weeks to the end of the spring semester.

According to M.I.T., the program develops students' abilities to communicate ideas and to integrate human relations problems with their engineering efforts. In addition, the students also must consider economic factors in their practice school problems and reach conclusions in the light of their economic as well as scientific worth.

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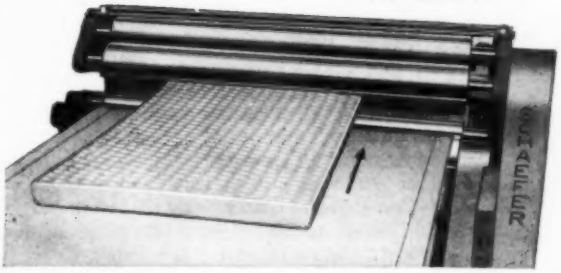

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names in the news

F. Kenneth Broome has been named manager of the newly formed Technical Information Department, Research Division of Armour & Co.

William A. Woodcock has been named vice-president and general sales manager of chemicals and plastics at Union Carbide International Co.

Charles M. Coffin has been named vice-president of manufacturing for the B. F. Goodrich Industrial Products Co. He succeeds **Rollin D. Hager** who is on an extended leave of absence.

James F. King has been named assistant to the president in charge of government relations for Manufacturing Chemists' Association, succeeding **Claude E. Hobbs.**

R. D. Halford has been appointed general manager of the Packaging Materials Division, Fabricon Products Division of the Eagle-Picher Co.

Frank J. MacRae has been named plastics technical service manager at Dow Chemical Co.

Wayne J. Holman, Jr., chairman of the board for Chicopee Manufacturing Corp. and Chicopee Mills, Inc., affiliated companies of Johnson & Johnson, and Permacel, a division of that company, has been elected to the board of trustees of New York University.

Ralph M. Knight has been made manager of polyolefin planning and application at U.S. Industrial Chemicals Co.

M. D. Payn is appointed Rocky Mountain District Manager for OPW-Jordan, Cincinnati, Ohio.

Homer A. Smith has been named assistant manager, Chemical Distributor Operations, Minerals & Chemicals Corp. of America, Menlo Park, N.J. He is an AIMME member.

Howard D. Shorts assumes the duties of manager of the Urethane Foam Application Laboratory, Chicago, Ill.

Plans Stock Split

At a special meeting, called for March 23, stockholders of Reichhold Chemicals, Inc., White Plains, N. Y., will be asked to approve a recommendation by the board of directors to split the stock, two-for-one. Under the proposal, authorized capitalization of the company would be increased to 10 million shares from three million shares. Outstanding stock would double to 2,522,180 shares from the 1,261,090 listed by the company in its annual report for 1957. Reichhold said that the board has indicated its intention to raise the quarterly dividend, should the split be approved. The new stock would be placed on a quarterly dividend basis of 15¢, which would be equivalent to 30¢ on the present stock. The company recently declared the usual quarterly dividend of 25¢ on the present stock, payable February 16 to holders of record January 23.

Morningstar Expands

Morningstar-Paisley, Inc., New York, N.Y. has announced a number of new developments in starch, gum and resin products for the paper industries. In addition, the company reports that a sizable expansion of its resin facilities in its Clifton, N.J., plant is expected to accelerate the further development of specialized coatings and adhesives for paper manufacturing and converting. According to the company, three new resin products are now available to the paper industries; they are: Greaseproof Coating R-1019, a modified polyvinyl acetate resin emulsion compounded to meet the needs of the food, bakery, confectionery and meat industries for greaseproof trays and cartons; Vinylmul 2849, a polyvinyl acetate copolymer having features for scuff-proofing paperboard; and Vinylmul 2659, a polyvinyl acetate homo- and co-polymer.

Portrait of

JACOB LICHMAN

A charter member of the ADHESIVES AGE Editorial Advisory Board, Mr. Lichman is development manager for The Borden Chemical Company's Coatings and Adhesives Department. He is responsible for activities at the Central Research Laboratory, Peabody, Mass., and the Technical Service Laboratories in Middlesex, N.J., Chicago and Toronto.

After graduating from Boston University as a Phi Beta Kappa, in 1934 he went to work as a development chemist for the Bay State Chemical Company, manufacturers of leather finishes. He was one of the original participants in the American Resinous Chemicals Corp. which was formed to produce and market resin emulsions that were just being produced.

In 1952, he became general manager of the American Monomer Corp. which was formed in association with the American Research and Development Corp., American Resinous Chemicals Corp. and American Polymer Corp. to manufacture and market monomers and solid polymers. When the American Monomer Corp. had been placed on a sound operating basis, he returned to American Resinous Chemicals Corp. as vice-president in charge of research.

Mr. Lichman assumed his present position in 1955, when The Borden Chemical Company acquired ARC and began to operate it as the Coatings and Adhesives Department.

Plans Research Project

Plastics Group of the Manufacturing Chemists' Association, Washington, D.C., is sponsoring a basic research project into the behavior of polymeric or plastic materials in the solid state, which is being undertaken at the Case Institute of Technology, Cleveland, Ohio. This is another phase in the three-fold objective of the Plastics Group to promote research that will increase basic understanding of the physical behavior of plastics; to train students in the science and technology of plastics; and to act as liaison between the plastics industry and university and professional organizations.

The research, under a $15,000 annual grant, will be directed by Selby M. Skinner, associate professor of chemistry at Case Institute, who has previously directed research work related to some of that which is now underway. Initial studies will be devoted to precision tensile tests, impact tests, their correlation with measured moduli, and the utilization of results to develop clues as to the mechanisms involved when plastic materials fracture. Experiments will be designed to cover areas hitherto incompletely explored.

New Firm Formed

Formation of Elion Instruments, Inc., in Bristol, Penna., has been announced by H. A. Elion, who will serve as president of the new firm. Mr. Elion was formerly chief engineer of Paul Rosenberg Associates and group leader for advanced development of scientific and industrial instruments at Radio Corp. of America. According to Mr. Elion, the firm will specialize in research, development and production of ultrasonic transducers, electron spin resonance equipment and x-ray microanalyzers. It will also conduct consulting and development services in electronic plasmas, high voltage engineering and medical electronics, Mr. Elion stated.

Tamms Combines Units

Tamms Industries Co., Chicago, Ill., has announced the combining of its Raw Material and Foundry and Flooring units into a single Flooring and Industrial Materials Department. The new department will be headed by Fred W. Knisley, vice-president, who formerly headed the Foundry and Flooring Sales Department. Louis R. Wahl, formerly assistant sales manager of the company's Raw Material Division will be Mr. Knisley's assistant.

No. 3 of a Series

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April 5-10. American Chemical Society, Biltmore Hotel, Boston, Mass.

April 5-10. Atomic Industrial Forum-Atom Fair, Cleveland, Ohio.

April 6-8. 8th Annual Meeting of the Building Research Institute, Penn-Sheraton Hotel, Pittsburgh, Penna.

April 13-17. National Packaging Exposition, International Amphitheatre, Chicago, Ill.

April 14-17. Toy Production Show, New York Trade Show Building, New York, N.Y

April 25-30. Scientific Apparatus Makers Association, White Sulphur Springs, W. Va.

April 28-29. American Society for Testing Materials, Committee D-14 on Adhesives, University of Michigan, Ann Arbor, Mich.

April 29-30. Manufacturing Chemists' Association, Engineering and Scientific Center, Cleveland, Ohio.

May 6-8. 36th Annual Meeting of the American Institute of Chemists, Hotel Traymore, Atlantic City, N.J.

May 17-21. 61st Annual Meeting of the American Ceramic Society, Palmer House, Chicago, Ill.

May 25-27. 10th TAPPI Coating Conference, Statler Hotel, Boston, Mass.

May 25-27. 42nd Annual Conference of The Chemical Institute of Canada, Halifax, Nova Scotia.

May 25-28. Design Engineering Show, Convention Hall, Philadelphia, Penna.

May 25-28. Office Machinery & Equipment Exposition, Municipal Auditorium, New Orleans, La.

June 9-12. Material Handling Institute Exposition, Public Auditorium, Cleveland, Ohio.

June 15-19. Annual Meeting of the American Society for Engineering Education, Pittsburgh, Penna.

June 21-26. American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N.J.

June 22-27. Railway Supply Mfrs. Association, Convention Hall, Atlantic City, N.J.

July 1-19. Chicago International Fair Exposition, Navy Pier, Chicago, Ill.

July 6-10. Gordon Research Conference, Polymers, Colby Junior College, New London, N.H.

Aug. 18-21. 10th TAPPI Testing Conference, Multnomah Hotel, Portland, Ore.

Aug. 31-Sept. 4. Gordon Research Conference, Chemistry of Adhesion, New Hampton School, New Hampton, N.H.

Sept. 10-11. ASME Wood Industries Conference, Multnomah Hotel, Portland, Ore.

Sept. 21-25. 14th Annual Instrument-Automation Conference and Exhibit, International Amphitheatre, Chicago, Ill.

Sept. 27-30. American Institute of Chemical Engineers, St. Paul, Minn.

Oct. 7. Society of Plastics Engineers, Cleveland Section, Cleveland, Ohio.

Jan. 12-15, 1960. 16th Annual Technical Conference, Society of Plastics Engineers, Conrad Hilton Hotel, Chicago, Ill.

Eastman Unit Expanded

Tenite Plastics Development Laboratory of the Tennessee Eastman Co., manufacturing division of Eastman Kodak Co., Kingsport, Tenn., has been enlarged by approximately 5,000 square feet in order to accommodate additional equipment and personnel. The new addition increases the facilities available to Eastman Chemical Products, Inc., marketing subsidiary of the company which is headquartered at Kingsport. The facilities will be used to broaden Eastman services to the plastics processing industry and to expand study of the potentialities that Tenite plastics offer to allied industries.

New equipment at the laboratory includes an overwrap machine which can wrap up to 100 boxes per minute in polyethylene film, and a laminating machine that applies a polyethylene film as thin as ⅛ mil on paper or other materials at speeds up to 900 feet per minute. The laboratory has also installed a machine that can coat 12- through 25-gauge wire at up to 3000 feet per minute on smaller wire sizes and an infrared spectrophotometer which is said to permit quick analysis of new materials and the composition of plastics. A two ounce molding machine is being used to study properties of injection-molded Tenite plastics, while a 3½ inch extrusion machine supplements laboratory equipment for extrusion processing.

Forms New Company

Armour & Co., Chicago, Ill., has announced the formation of Armour Alliance Industries with headquarters at Alliance, Ohio. The formation was made by combining the adhesives, coated abrasives and cushioning products operations of Armour. The company has named Carl B. Johnson as general manager of Armour Alliance Industries, succeeding R. L. Reeves, and R. W. Guthiel has been named marketing director. Mr. Johnson was formerly production manager of the Soap Division in Chicago. He joined Armour in 1949 as general superintendent of the Armour Auxiliaries. Mr. Gutheil has been with Armour since 1954 and formerly was general manager of the Adhesives Division. Mr. Reeves formerly headed the Alliance Divisions which were composed of the cushioning products and coated abrasive units.

Sales And Earnings Up

National Starch Products Inc., New York, N.Y., has reported record sales and earnings for the year which ended December 31, 1958. According to the company, net earnings after taxes amounted to $3,130,667 or $3.17 per share of common stock, compared with $2,676,535 or $2.72 per share in 1957. The 1958 earnings include a non-recurring credit equivalent to 23¢ per share, reflecting the use of a tax carry-forward loss incurred by Granite Board Inc. prior to its consolidation into National Starch Products.

The increase in earnings has been attributed to profitable new products recently developed by the company's research and development program, and to manufacturing economies resulting from the installation of new plants and equipment. Net sales for 1958 amounted to $46,200,145, compared with $43,745,779 in 1957. This increase was due primarily to expanded volume in both new and established products, the company states.

During 1958, the company authorized $2,000,000 for new and improved manufacturing facilities, including a 50 per cent expansion in the productive capacity of its Meredosia, Ill., polyvinyl acetate plant to be completed in April, and the completion of a new warehouse in Chicago in December, 1958. This part of the company's expansion program is proceeding on schedule and is expected to be completed early this year.

ASTM Test Completed

According to a recent announcement by the American Society for Testing Materials, a study to determine the effects of rate of loading on the results being obtained in the method of test for strength properties of adhesives in shear by tension loading (metal-to-metal D 1002) has been completed. Analysis of the results of interlaboratory work of tests on some 960 specimens at four rates of loading indicate that the rate effect was negligible.

The climbing drum peel test, which has been accepted by government agencies, will be presented to the ASTM for acceptance in June. A broad spectrum of work for wood adhesives, metal-to-metal adhesives, and adhesives for plastics has been initiated through three new subcommittees organized with both West and East Coast groups. Work of the wood adhesives subcommittee is underway.

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Box Shipments Down

Folding Paper Box Association of America, Chicago, Ill., has announced that January shipments of folding paper boxes were off 3.6 per cent in dollar volume and 5.3 per cent in tonnage from the same month last year. According to the association, industry volume totaled $71,300,000, down $3,300,000 from January 1958. Folding carton shipments aggregated 178,600 tons, off 12,000 tons.

The association reports that the Pacific area, going against the national picture, showed a gain of 2.7 per cent in dollar volume of shipments in January over the same month in 1958. The eastern and north central sections registered declines of 4.3 per cent and 3.4 per cent, respectively, and one southern area off 11.9 per cent.

Viewing the upcoming months with confidence, the association announced that the dollar value of new orders for folding paper boxes in January topped the figure of a year ago by 4.3 per cent on increased tonnage of 1.9 per cent.

Avco Names Executives

Avco Manufacturing Co., Cincinnati, Ohio, has announced the appointments of Dr. Leonard C. Maier as vice-president, marketing (defense products), for its Crosley Division, and Louis R. Zimov as vice-president, manufacturing for the division. Prior to joining Avco, Dr. Maier was associated with the General Electric Co. as manager of Industrial & Military Tube Operation of its Cathode Ray Department. He received his B.A. degree in physics from Williams College in 1944, and his M.S. and Ph.D. degrees in physics from Massachusetts Institute of Technology in 1948 and 1949 respectively.

Mr. Zimov is a graduate of the University of Cincinnati from which he received an electrical engineering degree in 1939. Prior to joining Crosley in 1942, he was employed by Sunbeam Electric Manufacturing Co. as assistant chief engineer.

New Hooker Promotion

James W. Ferguson has been promoted to manager, field sales of the Durez Division of Hooker Chemical Corp., Niagara Falls, N.Y. He had been assistant product manager of industrial resins, since 1947.

Avery And Fasson Merge

Avery Adhesive Label Corp., Monrovia, Calif., has announced that it and Fasson, Inc., Painesville, Ohio, have been combined as one corporation under the name of Avery Adhesive Products, Inc. Each will continue to operate as divisions of the corporation, through separate sales, manufacturing and research organizations, under the new names of Avery Label Co. and Fasson Products. According to a company spokesman, the move was designed to coordinate the firm's corporate activities and would not affect Avery operations in the U.S. or those of its foreign subsidiaries. The Avery Label Co. and Avery Canada Ltd., Toronto subsidiary, will continue to handle development, production, and sale of converted self-adhesive products. Fasson Products and Avery Nederland, N.V., Holland subsidiary, will continue to concentrate on the development, production, and sale of primary self-adhesive products and base materials.

Rawlings Named To Board

General Mills, Inc., Minneapolis, Minn., has announced the election of Edwin W. Rawlings, retired general of the U.S. Air Force, to the board of directors, and his appointment as financial vice-president of the company. According to General Mills, Mr. Rawlings, who had more than 30 years' service with the Air Force, previously headed the Air Material Command, which buys, stores, transports, and maintains the aircraft and equipment used by the Air Force. At General Mills, he will supervise activities of the comptroller's, treasurer's and commercial development departments, assuming responsibility for the broad financial planning of the company. He will also serve on General Mill's executive council.

Reichhold Equips Plant

Reichhold Chemicals, Inc., White Plains, N. Y., has equipped its Ballardville, Mass., plant to manufacture ten million pounds of acrylic emulsion a year, including a new line of products for the surface coating and leather finishing industries. The company's acrylic ester emulsions, called Acripols, possess very fine particle size, which is said to contribute to outstanding stability. The clear films also show excellent clarity, and the various products offer a broad range of flexibility, Reichhold states.

The company has also announced plans to construct a chemical manufacturing plant at Niort, its second plant in Paris, France. The Niort plant will be built by Reichhold-Beckacite, an affiliate of RCI. Production will consist largely of formaldehyde with a monthly capacity of 600 tons. This will be the second European formaldehyde plant within the RCI organization. The first plant, located at Hamburg, Germany, went on stream in April, 1958.

Hooker Appoints Four

Hooker Chemical Corp., Niagara Falls, N.Y., has announced the appointment of Dr. Chris A. Stiegman, formerly technical director, to the corporate position of director of research. He will be in charge of all research at the corporate level, embracing both chemical and plastics research. The company also has announced the following appointments: Dr. J. Howard Brown, formerly general manager of Niagara research and development, has been named general manager of chemical research; Dr. Alvin F. Shepard, formerly resident director of the LeRoy, N.Y., laboratory of the Durez Plastics Division, has been appointed general manager of plastics research; and James S. Sconce, formerly technical assistant to management, has been assigned to the post of technical assistant to the director of research

Conduct Adhesives Study

The Rubber Manufacturers Association, Washington, D. C., has announced that a subcommittee of its Heel and Sole Division's Technical Committee is now at work with representatives of the adhesives industry in an effort to develop uniform methods for testing adhesives used to attach soles to shoes.

Reports Sales Decline

Hercules Powder Co., Wilmington, Del., has reported net sales and operating revenues of $236,513,000 for 1958, a decline of 4 per cent from the 1957 record of $245,265,000. The company's 1958 Annual Report to stockholders showed net income, after all charges, of $17,509,000, which is equal to $2.04 per share of common stock. This represents a decline of 5 per cent from 1957, when net income totaled $18,116,000, or $2.14 a share of common stock. Common dividends were $1.10 a share, the same as those of last year.

About $14 million was spent by Hercules for plant construction during 1958, a little more than half the amount spent in 1957. Construction expenditures this year "are expected to exceed those of the year just ended," according to A. E. Forster, chairman of the company. In viewing 1959, Mr. Forster said, "Most forecasts are that this year will be a better year for business than 1958, and Hercules is in excellent condition for continued growth and development."

Borden Names Salzberg

Borden Chemical Co., New York, N.Y., has announced the appointment of Harold K. Salzberg as senior scientist at the company's sales development laboratory in Bainbridge, N.Y. Louis E. Georgevits has been named to succeed Mr. Salzberg as head of the laboratory's Casein Section, and Curtis Booth, in addition to his present duties as head of the Wood Products Section, assumes Mr. Salzberg's former responsibility for the Foundry and Abrasive Section. David J. Lieb, head of the resin section, has been placed in charge of the Analytical Department.

Packaging Report Issued

British Productivity Council has published a report entitled "Packaging Productivity Review 30" which deals with modern packaging materials and methods and their potential effect on productivity. According to the review, packages have an profound effect on sales. Sales of a package designed for a traditional foodstuff were said to have reached 15 million in nine months.

Pliability Tester

American Instrument Co., Inc., Silver Spring, Md, has announced a new instrument, the Aminco Pliability Tester, that simulates the action of wrapping a paper-like material around an object and measures the paper's resistance to this operation. According to the company, this tester is the first instrument to offer a method of accurately measuring, quantitatively, the pliability of paper and similar products such as greaseproof, water-proof, water-vaporproof barrier materials and flexible cushioning wraps. The company reports that the instrument is portable, completely self-contained and easy to operate. A unique sample cutter, incorporated in the instrument, cuts identical samples for each test. According to Aminco, the pliability tester operates as follows: a test sample (10 inches in diameter) is placed beneath a metal ring and a hemispherically-domed piston is driven upward forcing the test sample through the ring. The force exerted on the piston indicates the pliability of the sample, and this force is read on a dial gage calibrated in pounds.

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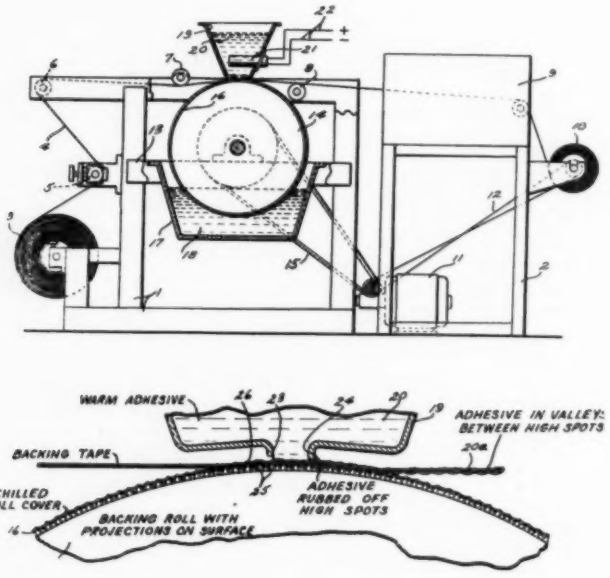
patent review

By MELVIN NORD

Porous Adhesive Tape

U. S. Patent 2,861,006, issued November 18, 1958 to Ferdinand Salditt, assigned to the Scholl Mfg. Co., Inc., describes a method of producing an adhesive tape that is porous or pervious to air and is highly desirable for application to the human body as a medicinal or surgical tape, as well as for use as a masking tape.


WARM ADHESIVE
ADHESIVE IN VALLEY BETWEEN HIGH SPOTS
BACKING TAPE
CHILLED ROLL COVER
BACKING ROLL WITH PROJECTIONS ON SURFACE
ADHESIVE RUBBED OFF HIGH SPOTS

As shown in the two schematics, the producing mechanism includes a main frame (1) with an auxiliary frame (2) adjacent. On an offset portion of the main frame, a backing supply roll (3) is mounted for free rotation, and from this roll a strip or sheet of backing material passes through the machine.

As the sheet or strip (4) leaves the supply roll (3), it passes over a tensioning roll (5), and then over a guide roll (6), under a guide roll (7), over a guide roll (8), through a tunnel (9) containing drying apparatus, and after leaving the tunnel, the finished adhesive tape is wound upon a receiving roll (10). This receiving roll (10) is driven by an electric motor (11).

Mounted on an intermediate support (13) is a relatively large drum (14) rotated by means of a belt (15) from the power unit (11). The drum is provided with a covering (16) of fabric or other material capable of absorbing and carrying water. The drum rotates in an open topped vat (17), which contains cold water.

Disposed above the open bed of the machine is an adhesive supply hopper (19) containing a mass of soft adhesive (20) which is kept at elevated temperature by means of a heating unit (21). The hopper (19), is provided with a flanged opening in the bottom (23), and the flange on the trailing side of this opening in the direction of travel of the sheet (4) is extended to form in effect a doctor blade (24) to insure a proper application of adhesive (20) to the sheet (4), as indicated at 20a.

The drum (14) is provided with numerous pointed projections (25) over the entire outer surface of the drum. These projections may punch completely through the absorbent covering (16) so that they contact the backing sheet (4) through the absorbent covering, but they do not punch through the backing sheet. Thus, the projections (25) on the surface of the drum cause deviations (26) in the backing sheet (4), and the height of each deviation or high spot is such as to afford at least a light contact with the doctor blade (24), so that at each high spot on the backing (4) substantially no adhesive will be applied, but the adhesive will occupy the entire surface between the high spots.

Pressure-Sensitive Adhesive

U. S. Patent 2,861,899, issued November 25, 1958 to Edwin E. Sylvester and Sumner H. Peck, assigned to B. B. Chemical Co., relates to the manufacture of pressure-sensitive adhesive sheet material and to a new pressure-sensitive adhesive composition.

According to the present invention, the difficulties of forming a pressure-sensitive sheet by known method of solution or dispersion coating are eliminated by providing a new heat stable pressure-sensitive adhesive involving an unusual combination of resins, and applying the adhesive in molten form. The new combination of resins in molten form is freely fluid to enable the adhesive to be supplied and to be spread on a surface of a backing by a new system employing simple gravity feed. The resin combination possesses the further important characteristic that it sets up rapidly to an aggressively adhesive film which is also firmly cohesive to give a strong bond between the backing and a surface.

The new adhesive is a mixture of polyvinyl alkyl ethers and certain styrene polymer resins. The latter, which are combined with polyvinyl alkyl ethers according to the present invention, are members of a class of resins not normally considered as useful in polyvinyl alkyl ether compositions. These resins are polymers, of styrene or mixtures of styrene and styrene homologues, for example, the crude mixture obtained from the fractionation of the so-called "crude solvent" from "light oils" scrubbed out of coke oven or gas house gas. Only relatively low molecular weight materials are useful, and the commercial resins available under the trade name Piccolastic have been found particularly satisfactory.

Roofing Composition

U. S. Patent 2,859,125, issued November 4, 1958 to Ralph R. Uhrmacher and assigned to Panther Oil & Grease Mfg. Co., describes an asphalt roofing composition in which an asphalt blown in the presence of a phosphorus pentoxide catalyst is thinned with a solvent to form a weatherproof coating when spread on roofing felt.

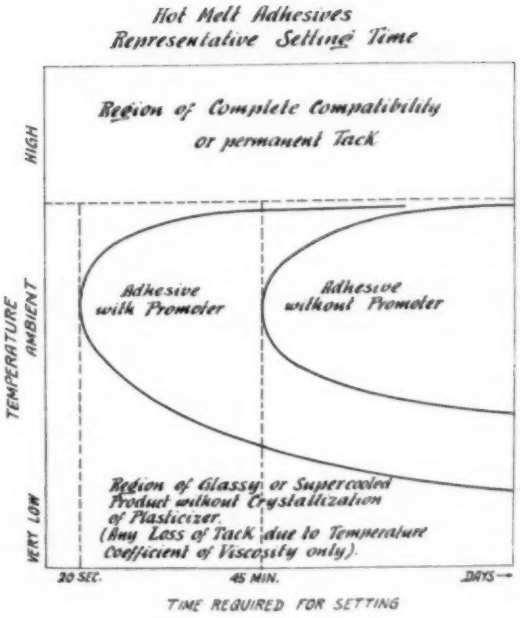
The addition of the phosphorus pentoxide to the asphalt forms chemical unions with the traces of metals found in air-blown asphalts, to produce stable mineral compositions that do not react with the solvent to form a non-adhesive skin such as that formed with air-blown asphalt solutions.

Delayed-Set Adhesive

U. S. Patent 2,861,002, issued November 18, 1958 to Richard K. Britton and assigned to the Borden Co., relates to a hot melt adhesive composition of controlled, dependable setting action as the composition cools through a narrow range of temperature below the elevated temperature at which it has a viscosity sufficiently low for application.

The adhesive composition is useful in many operations in which an adhesive composition is applied to a surface to be adhered to another surface. An example is the plying of paper and aluminum foil. An adhesive is softened by heat just before or at the time one adhesive coated surface is pressed against another. The ply is then cooled, to cause hardening or setting of the adhesive. Other examples are the use as the cement in the side seams of metal cans, application of labels to cans, and sealing of the flaps of cartons. The hardening or setting of the composition is caused by the separation of a plasticizer as the adhesive cools or within a limited controlled time of cooling.

The present invention provides a process and product that delays the set for the few seconds or more required for the application and sealing, but avoids long delay which would interfere with continuous assembly-line type of use. Briefly stated, the invention consists of an anhydrous combination of a crystalline solid, an adhesive, and a setting promoter. The solid, when molten, serves as a viscosity reducing agent (plasticizer) for the adhesive and separates when and if crystallization from the adhesive occurs on cooling.



The setting promoter provides extensive surface and closely spaced undissolved solid particles throughout the melt at the time of the cooling and separation.

With such a composition, there is obtained briefly delayed, dependable hardening or firming of the adhesive composition within a limited time after cooling below the temperature of application of the adhesive. Thus, a representative adhesive composition, when applied to flaps of cartons at a temperature of 102°C. and allowed to cool, sets to a firm bond in about 30 seconds after the coating is completed. This delay is sufficient to permit the sealing of a carton by application of pressure only, using cold jaws, without reheating or maintaining the adhesive film at a high temperature after application. Sealing to a cold surface during the delay period is also possible.

The diagram is an idealized presentation of the effect of the setting promoter on the length of the delay period before the adhesive sets after the hot application of the adhesive to a surface.

Other Patents of Interest

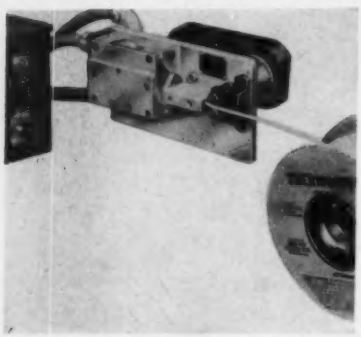
Subject	Inventor or Assignee	Patent No.	Date
Dry wall joint taping apparatus	Gladney W. Harrell	2,858,953	11/4/58
Label securing attachment	Oliver Machinery Co.	2,858,954	11/4/58
Composition for preventing putty stains	Roy E. Reno	2,859,126	11/4/58
Production of blown asphalts	Standard Oil Co. (Ind.)	2,859,167	11/4/58
Textile size	Monsanto Chemical Co.	2,859,189	11/4/58
Paste spreading machine for floors	Marcus Shafer	2,859,462	11/11/58

Copies of patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

Adhesive Applicator

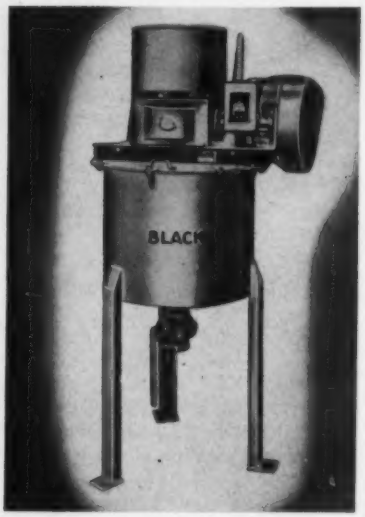
A new type of hot melt adhesive applicator is designed to feed, melt and apply cord-like adhesives. Designated Thermogrip Applicator, Model CW, the device complete with electrical heat controls is said to be incorporated easily into machines where a gluing operation is required. It uses a transfer wheel method of applying the molten adhesive to individual passing package surfaces or other objects. The wheel can be designed to apply a variety of patterns. Typical applications include package ends, tabs, or sides, tip-ons and other non-package operations where automatic glue assembly is desired The unit functions equally well on its side or upside down, a unique feature that makes Thermogrip readily adaptable to a variety of uses and convenient gluing positions in existing



equipment. During operation the unit automatically feeds and melts from a reel of 3/16-inch diameter adhesive. This principle is claimed to protect the adhesive from heat damage and makes possible more effective formulations not practical with bulk melting pots. *United Shoe Machinery Corp.* E-63

Cold Glue Mixer

A line of glue mixers is applicable to preparation of all adhesives either in powdered or liquid form which are prepared without the use of heat. Features of the machines are 10 to 400 gallon capacities; a sifter for the glue powder; and double agitators, which also provide a beating action. Optional equipment includes water jacket, extra high legs and variable speed drive. In operation the water or other liquid ingredient is placed in a



tank made of heavy steel plates, after which the glue powder is added through the hopper at the top. Lumps in the powder are broken up by a revolving spider at the bottom of the hopper. The finely divided product is then forced through a grating into a chute which delivers it gradually to the liquid tank, where it is mixed. *Black Brothers Co., Inc.* E-64

Label Dispenser

An electric dispenser of pressure-sensitive labels, designated Model E6-6, requires neither a speed control nor a foot switch to operate. The

FOR MORE INFORMATION on the new equipment items described here, use the Reader's Service Card elsewhere in this issue.

units dispenses an entire row (one or more labels) at a time. Removal of the last label causes the next row to appear. This design is said to be ideal for either high-speed or variable-speed labeling requirements. The unit can dispense up to 100 inches of the labels per minute, in widths from 3/16-inch to 6 inches. Weight of the unit is 26 pounds, and dimensions are 15¼ x 8¾ x 6$^{3}/_{16}$ inches. *Avery Adhesive Label Corp.* E-65

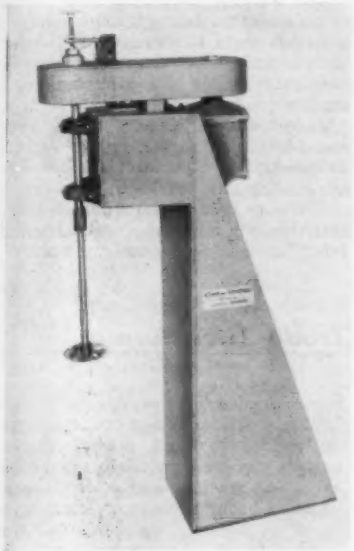
Drum Warmer

An unusual device for heating or cooling conventional 55-gallon steel drums consists of a single-embossed plate, tradenamed Platecoil. Steam, or hot or cold water, or other refrigerant may be introduced into the embossed areas through flexible connec-

tions to effect the heating or cooling. A quick-acting clamp and the flexible connections permit rapid transfer from one drum to another, or changing the location on individual drums. Insulated handles provide safe, easy handling of the drum warmer. The device is designed to simplify storage problems of certain materials, and to speed processing schedules. *Platecoil Division, Tranter Manufacturing, Inc.* E-66

Laboratory Mixer

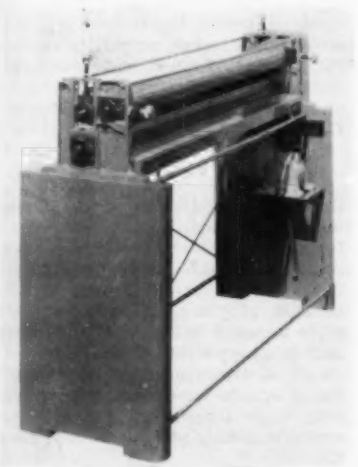
A laboratory mixer, called Model LM, features infinitely variable speeds to suit operating conditions and patented intensive type stirrers.



Horsepower of the electric motor is from ⅛ to 5, with motor specifications as required The base size and shaft length can be adjusted to suit the mixing containers being used. *Conn and Co.* **E-67**

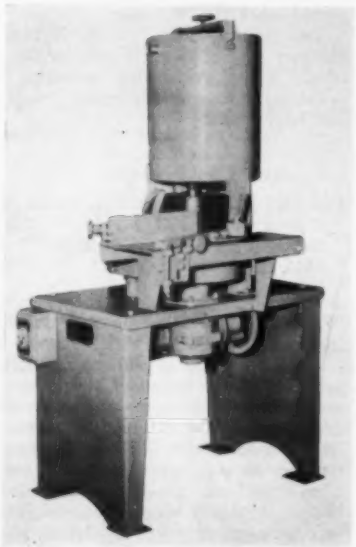
Coating Machine

A coating machine which applies adhesives and other materials to metals, masonite, plywood, paper products and other flat surfaces is said to save as much as 40% on labor and material costs. The machine is designed to coat up to 3800 linear feet per hour, or 15,000 square feet of material, which can be as wide as 48 inches. Up to 850 square feet are covered by a gallon of the material being applied The machine will process surfaces which are 1½ inches in thickness. The rolls come with a screw-type adjustment which is said to be sensitive, accurate and dependable. The machine is 61½ inches in length, 46 ¾ inches in height and 20 inches in depth. *L. R. Wallace & Co.* **E-68**



Vertical Glue Spreader

A line of vertical glue spreaders applies glue to the edge of stock rather than to the top and bottom. The machine illustrated, one of the line, has a variable speed drive which provides a choice of 90 to 270 fpm, a one hp motor, a water-jacketed glue pan and water-jacketed supply reservoir with automatic gravity feed. Also provided are a floor stand for 36-inch pass line to handle 4-inch high and 6-inch wide stock, and a table which features an adjustable fence. *Black Brothers Co., Inc.* **E-69**

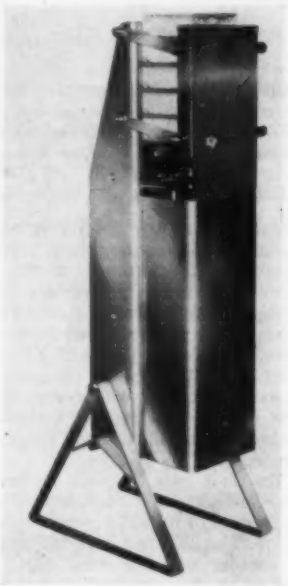


Ceiling Heater

A recessed ceiling heater, designated Pyrolite, Model RC, is said to be capable of heating large areas with unusual efficiency. Rated at 1000 watts, the unit is mildly fan-forced so that convection heat is gently circulated throughout the room. The units can be mounted separately or in groups of two or more. *Berko Electric Mfg. Corp.* **E-70**

Carton Sealer

A low priced carton-end gluer for moderate production needs, called the Minisealer, fills a compact space of four square feet, and weighs under 100 pounds. The machine is said to process 1000 or more units per hour with one operator. Loaded cartons are fed into the machine, which automatically glues and delivers them sealed, ready for case loading. The machine, which is stainless steel construction throughout, is powered by air or electricity. A principal feature is rapid set-up and clean-up time resulting from an all new glue applicator principle. *Alford Package Machines Inc.* **E-71**



Water Conditioner

A water conditioning instrument, called the Magnetron, is designed to prevent scale and corrosion by introducing energy to the salt and mineral molecules in the water. These energized molecules for a period of time lose their ability to adhere to themselves or to the metal over which they pass. The instrument is claimed to function as a permanent well of kinetic energy without the use of chemicals, compounds or detergents, and to permanently eliminate scale and corrosion in soft water, hard water, and sea water systems. Periodic visual inspection of the unit is said to be the only necessary service. *Magnetron Water Conditioner N. Y., Inc.* **E-72**

book reviews

Statistical Quality Control: An Introduction for Management. ***By D. H. W. Allan. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 5 x 7½ in. 130 pp. $3.50.***

Statistical quality control is becoming an increasingly important factor in manufacturing processes in this day when the demands for service life of products under specified conditions are becoming more severe, and the costs of replacing unfit goods higher. This book has been written for the executive who desires a working knowledge of this new management science without the necessity of considering the mathematical details of its practice.

The first two chapters answer the questions what is statistical quality control, and how does it fit into an organization. The next four chapters acquaint the reader with the basic SQC tools and where they are applied.

The seventh chapter deals with the statistical methods used for investigations and experiments describing their application and limitations. The last chapter is composed of lists of reading sources for the reader interested in pursuing further this modern management tool.

This volume is one of a series being prepared by the publisher on management science. It is a worthy offering to those in an economy which realizes that successful commerce depends on proper management of goods and people. It is also a valuable addition to the series, one which should prove of great value to the executive.

Paper Coating Pigments. ***(TAPPI Monograph No. 20). Published by Technical Association of the Pulp and Paper Industry, 155 East 44th St., New York 17, N. Y. 6 x 9 in. 236 pp. $7.00.***

Mineral coatings are generally applied to paper for one or a combination of the following reasons: (1) to impart a smooth and receptive surface for printing, (2) to mask or change the color of the raw stock, or (3) to impart opacity. This paper-bound book, which consists of 12 chapters by different authors from industry, offers a technical analysis of the different materials used for the coatings and their characteristics. It is a presentation in depth for the scientist, though other considerations, such as economic, are also discussed.

The effects of the adhesives used in bonding the pigments to the stock have a determining influence on the character of the final product. In analyzing the different pigments used for the coatings, the authors present considerable information on the adhesives—kinds used (thin boiling starch, oxidized corn starch, soya bean protein, casein, etc.); adhesive demand as determined by kind of pigment used; and effect of the adhesive ratio on brightness of the coated stock, for example.

The quality of the papers is high, and they contain valuable data for those of the adhesives industry involved in preparing bondants for coating paper and related fields.

Fabricating with Formica. ***By James M. O'Neill. Published by Bruce Publishing Co., Milwaukee, Wisc. 7 x 10¼ in. 64 pp. $3.50.***

The sub-title of this short book, "Procedures for Working with Plastic Laminate," indicates exactly what it is—a guide to working with commercially available plastic laminates for the non-professional hobbyist. Two chapters are devoted to gluing the laminates down. The first deals with flexible or contact-type cements, and gives information on what they are, how they are used, drying time and similar subjects. The second suggests other kinds of glue which may be used instead of the more convenient but also more expensive flexible cements. Caseins and ureas are recommended as satisfactory.

The book is short, concise, to the point, and well illustrated with photographs to show the various steps involved in applying plastic laminates. It makes a valuable guide for the home decorator.

Chemistry Made Easy. ***By Cornelia T. Snell and Foster D. Snell. Published by Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N. Y. 5¼ x 8¼ in. 687 pp. $10.00.***

This book on chemistry is designed specifically for home study and so presented as to make it easy for the reader to grasp the essential principles of the science by himself without a teacher. It covers the three main branches of chemistry: general, inorganic and organic. The book is divided into three parts, one for each. Each part includes over twenty chapters filled with the information, chemical equations, tables and illustrations necessary to give a well-rounded picture of the science.

The authors have chosen a simple and enjoyable style of writing to convey the great amount of information which must be presented in a survey of an entire science. This is commendable, for there is no reason why even theory and underlying principles of chemistry cannot be presented in a readily comprehensible manner.

Anyone who has no technical or scientific education will gain a working knowledge of chemical fundamentals by reading this book. In addition, it can serve as a refresher and ready reference for those who need chemical information in their everyday work.

Trade Literature

Commercial Adhesives. A new 12-page catalog describes design concepts, typical applications and general characteristics of commercially available adhesives, coatings and sealers. These include oil-soluble elastomeric adhesives based on natural, reclaimed and synthetic rubber; oil-resistant elastomeric adhesives based on neoprene and nitrile rubber with or without synthetic resin bases; and high strength structural adhesives which include epoxy resin products and adhesives made from combinations of synthetic elastomers and resins. Data on physical properties are provided. *Minnesota Mining and Manufacturing Co.* **L-69**

Adhesives for Plastics. Adhesives for bonding plastics are the subject of a 4-page technical bulletin. Described are products for bonding acrylics and joining polystyrene; for cementing dissimilar plastics and plastics to non-plastics; for bonding cellulose acetate to itself, or butyrate to butyrate; for cementing acrylics; and for bonding flexible and rigid vinyls, and for bonding vinyls to acrylics. For each of these materials characteristic properties and applications are detailed, and other information, such as flammability and health factors, are given if relevant. *Schwartz Chemical Co.* **E-70**

Roller Gravity Handbook. A 50-page booklet is suitable as a reference book for the engineer who uses conveyors to solve unit load handling problems. Diagrams and photos explain the application of gravity conveyors and the more common accessories, and charts and graphs provide data on how to match a conveyor to specified loads. Conditions to be avoided are pointed out. A great amount of data is presented succinctly and attractively. *Lamson Corp.* **L-71**

Trade Literature (Cont'd.)

Adhesive Raw Materials. Some of the raw materials produced by Shawinigan for use in adhesives are analyzed in a four-page brochure. These include Gelva polyvinyl acetate emulsions, solid resins and resin solutions, polyvinyl acetate derivatives, polyvinyl acetate copolymers; Gelvatol polyvinyl alcohol; and two acetal resins sold under the tradenames of Butvar and Formvar. Physical properties are described, and special advantages obtained by application of the raw materials in adhesive products are detailed. *Shawinigan Resins Corp.* L-72

Acrylic Ester Resins. An 18-page bulletin gives extensive data on a line of acrylic ester resins for coatings. Text describes the products, which have the tradename Acryloid, their characteristics and general properties. Tables give detailed information on physical properties, mutual compatibility and uses. Individual members of the line are analyzed in detail, and applications are described. Use of the resins as adhesives is treated by itself, the characteristics which make them desirable in specified applications being described and two methods of application presented fully. *Rohm & Haas Co.* L-73

Raw Materials. A 4-page bulletin gives information on some of the major adhesive applications for commercial products with the tradenames Gelva, Gelvatol, Butvar and Formvar. The kinds of adhesives which are discussed include heat seal, remoistenable, furniture, structural, fabric and solvent. Considerable technical data are included in the text. *Shawinigan Resins Corp.* L-74

Automatic Folder-Gluer. The construction design and operating advantages of the Comet folder-gluer for making corrugated boxes are described in an 8-page bulletin. Photographs and schematic diagrams are used to explain the working of the machine. Data on the types of boxes which the machine can process, production speed and related subjects are provided. *Universal Corrugated Box Machinery Corp.* L-75

Glue Preservative. Two materials, sodium benzoate and benzoic acid, are described in an 8-page brochure. Chemical formulas and other relevant information are given for the two, and commercial uses are described at length. The former is recommended as a preservative for paste, glue, starch and other organic materials. *Hooker Chemical Corp.* L-76

Construction Bondants. An illustrated 4-page catalog describes a complete line of adhesives and sealers for the building and construction industries. Roltite brand adhesives are used for contact bonding of high pressure decorative laminates and for installing tile, flooring, insulations and for similar applications. Weatherban sealers are employed for sealing curtain wall structures, duct systems, sheet metal structures and other uses. A table presents specific technical data on adhesion strength, tensile strength, weathering resistance and related properties. Other products are also described. *Minnesota Mining and Manufacturing Co.* L-77

Continuous Chemical Analysis. An 8-page brochure describes the Auto-Analyzer, an automated system for continuous chemical analysis. It shows how the compact system automates analytical procedures in the laboratory and controls product quality in the plant. Principles of operation and of the system's concept of automating each step of manual analysis and eliminating absolute measurements are detailed. A complete description of the components is given, and industrial applications are listed. *Technicon Controls, Inc.* L-78

Corrugated Gluer. A machine which scores, folds and glues corrugated cartons is described and illustrated in a 20-page brochure. The principle of operation and special features of the machine—including a non-clog gluepot designed to provide uniform gluing—are explained fully. Photographs and schematic diagrams are used to advantage. The gluer will produce from 10 to 12 thousand boxes per hour. *International Paper Box Machine Co.* L-79

Polysulfide Sealant. A 4-page bulletin supplies a pictorial report on polysulfide sealants in various structural applications. Emphasized are cast stone, masonry-to-masonry bonding and remedial sealing. Uses of these sealants in architecture are discussed in a general way, with advantage being detailed. Numerous photographs, many of nationally known buildings, enhance the presentation. *Thiokol Chemical Corp.* L-80

FOR MORE INFORMATION on the trade literature reviewed here, use the Reader's Service Card elsewhere in this issue.

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FOR SALE—World's largest stock of Baker-Perkins sigma blade, jacketed mixers: (43) 200 gal., (4) 100 gal., (5) 50 gal., (2) 35 gal. Prices are lower than ever before! Phone or write for details. PERRY EQUIPMENT CORP., 1414 N. 6th St., Philadelphia 22, Pa.

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in passing

New Language?

Suppose you were faced with any of the following words: Pernogra, Trafolpers, Furordmod, Shap, Utnotreq? Sound like Greek? Not at all, because according to the Navy the meaning of all these words, or terms, is "self-evident, unequivocal and universally known." At least that's what it says in the new 22-page dictionary recently sent to all ships and stations by the Bureau of Navy Personnel. Obviously, these terms are abbreviations of phrases and sentences used in messages for transfer and assignment of personnel, the idea being to make the messages shorter. With some thought, a few of these can be guessed with fair accuracy. For instance, Pernogra means "permission not granted," Trafolpers means "transfer following enlisted personnel," Furordmod means "orders further modified," and Shap means "where and when applicable." The one we like best is Utnotreq, which is defined as follows: "While performing this duty, utilization of government facilities is not required, as it is considered such utilization would adversely affect the performance of the assigned duty." But, of course!

Integrity

Recently a company that manufactures wall coverings of various types attempted to develop a new kind which would have a pressure-sensitive backing. They called on several adhesive manufacturers. Everyone they called on gave them a product. None succeeded. The material proved too heavy to stay on a wall with the poor adhesive supplied.

With the passage of time and the continued failure of their pet project, the company began to distrust all adhesives manufacturers, and quietly accused them of being "fast-buck" artists. Then, quite by accident, the case came to the attention of one of the leaders in the field. They called on the company, carefully diagnosed the troubles and the problems, and submitted an answer which has restored the faith of the wall coverings maker.

The final answer was that their most recent approach to the idea was the best and most likely to succeed. Anything which they might supply would be either too expensive or risky. The best idea yet was the one wherein a paper backing would be added to the wall covering—then the whole thing could be applied to a wall with wall paper paste if they liked.

The response of the manufacturer has been a happy one and they now believe that adhesives manufacturers are decent people after all. Such integrity is to be applauded by the industry.

Sticky Stuff

The following item appeared in the columns of a recent issue of the *Portland (Ore.) Times*: "Freelance Design Studios of Portland have found the sure fire way of maintaining a steady clientele for their artwork. Their cleaning woman spilled an entire bottle of rubber cement on the front steps the other day. So far, all efforts to remove the sticky stuff have failed, and the Saturday mail delivery on the street was delayed somewhat while the mailman tried to unstick himself. Evidently the bit about 'sleet and snow' stops short of rubber cement." We have no comment.

Glulam Beams

Ward Mayer, of Portland, Oregon, started making glue-laminated wood beams and arches some twenty years ago. These beams, often referred to as "glulams," are used in the construction of churches, hangars, field houses, shopping centers, warehouses and wherever there is need for unbroken, clear-span floor area. According to an item in a recent issue of *Fortune*, there are now between twenty-five and thirty-five companies producing "glulams" and their combined gross is somewhere in the neighborhood of $100 million a year. That's a nice neighborhood for any company or product. For the record, these glue-laminated wood beams have been produced in Europe since 1904.

Roofing Strips

We have referred in these columns before to the "I'd Like to See Them Made" pages of *Popular Science*. While some of these suggestions are real zany, some of them make good commercial sense. A recent item which intrigued us called for "roofing strips of double-faced, pressure-sensitive adhesive that could be placed under gale-loosened shingles to seal and anchor them securely." There's another idea for some progressive manufacturer.

Ain't It the Truth!

Sign on a street in Akron, Ohio, with more truth than poetry: If more of us drove right, more of us would be left.